E ENGINEERING CONSTRUCTION WEEKLY · BRIDGES · IRRIGATION · FLOOD CONTROL · FOUNDATIONS · DAMS ·

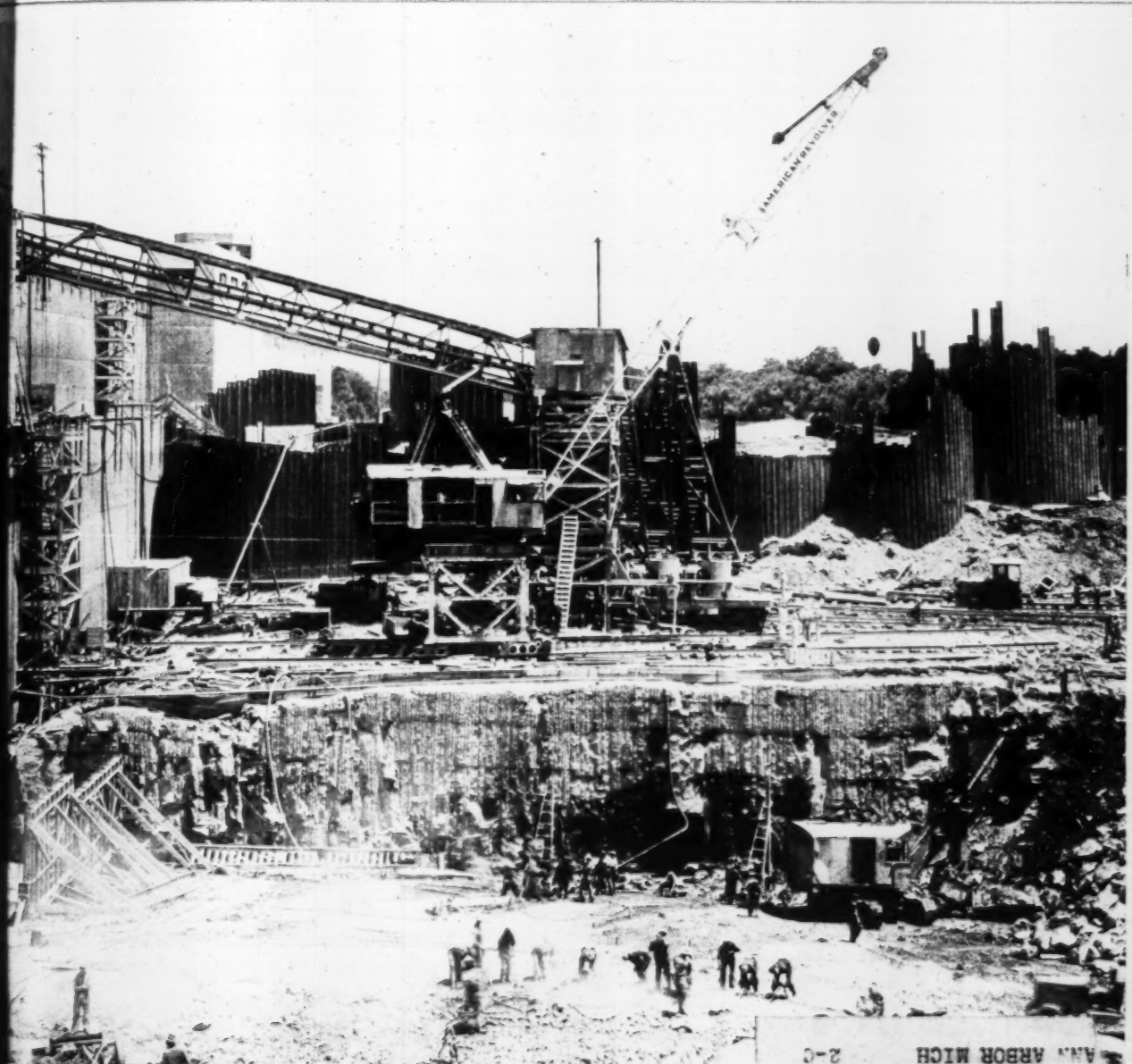
RA HILL PUBLISHING COMPANY, INC. · TWENTY-FIVE CENTS, FIVE DOLLARS PER YEAR

eering
rary

OCT 22 1937

Engineering NEWS-RECORD

October 21, 1937



UNIVERSITY OF MICHIGAN
GENERAL LIBRARY
ANN ARBOR MICH 2-C

BYERS WROUGHT IRON

● The engineers, responsible for many of the country's most efficient sewage treatment plants, realize the importance of unfailing service and low maintenance cost. Furthermore, their choice of wrought iron for corrosive services is a matter of sound engineering as well as community interest.

Municipal engineers have used Byers Wrought Iron over a sufficiently long period of years to prove beyond any question its superiority in resisting the corrosion of the sulphides, nitrates, chlorides, phosphates and carbonates — both gases and liquid — common to sewage treatment.

One of the outstanding communities with an efficient sewage disposal plant is Akron. Because Byers Wrought Iron gave good service before, it was again used for heating coils in the additional sludge digestion tank (illustrated), also for sludge gas lines, air lines, hand railings, plumbing lines, and weep pipes.

If you are planning a sewage treatment plant or any other construction job where corrosion makes short life of ordinary pipe, plates, or sheets, we suggest you consider Byers Wrought Iron. Our Laboratory and Field Engineers are at your service in analyzing corrosive conditions. Give us a brief description of the type of project you are now working on and ask for the illustrated technical bulletin, "Wrought Iron in Sanitary Systems," recently published. A. M. Byers Company. Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

BYERS GENUINE WROUGHT IRON

Tubular and Flat Rolled Products

Specify Byers Genuine Wrought Iron Pipe for corrosive services and Byers Steel Pipe for your other requirements

"Little Knowledge and Much Opinion"

WITH INCREASING FREQUENCY one hears doubts as to just how effectively our elaborate American system of education contributes to the well-being of the individual and of modern society. A generation ago a father thought he had done a good job if he sent his son to high-school; for his daughter that still was rated as a luxury or a bit of swank. A college education for the boys indicated either exceptional wealth or an unusual aspiration to academic learning.

But soon every parent wanted to get his children out of the manual-labor or craftsman class. The white collar job became the symbol of an easier life and a higher social status. "Let other people's children do the hard work that I've had to do," was the feeling of the American parent. "Mine shall have all the 'advantages' that I can give them." So the high-school became a minimum and the college a norm to be achieved if at all possible.

Naturally, faced by the need for earning a living, more and more of the new college students went in for one of the professions. Education became highly practical. It aimed to help the individual into a higher bracket of earning power rather than to enrich his intellectual and cultural life. But, as usual, supply and demand were on the job, and before long the graduates, their parents and people in general began to wonder why the objects for which they had sacrificed did not materialize. Hence the murmurs.

THESE DOUBTS have spread amongst the rank and file of our people; today many parents take a much more conservative view as to the necessity or even the desirability of their young hopefuls "going to college" before they go to work. And within the last few weeks two prominent voices have spoken on the subject. One is that of a business man, the other of an educator. W. Averell Harriman, Chairman of the Board of the Union Pacific Railroad, himself a graduate of Yale, is quoted as questioning the value of a college education to the railroad man. He says, "the chief handicap a college boy has is in the hard transition. He has been used to having things pretty easy. He has been studying broad subjects. To be compelled to occupy himself with the monotonous details he finds when he starts with a railroad is pretty grinding."

It may be assumed that Mr. Harriman is not talking about the railroad lawyers and engineers whose college courses are devoted to special training, often as "grinding" as the railroad job. But he does question whether the so-called higher education helps a young man to make good in the broader fields of railroad operation and management. And if his question is pertinent, to what extent does it apply also to the non-specialized phases of all business and industry?

THE OTHER WITNESS is Dr. Robert M. Hutchins, President of the University of Chicago, who is quoted as saying that despite our elaborate educational system, the American people remain uneducated. "They may have acquired a good deal of information," he asserts, "but they have not learned to think, as their pitiful efforts to read, write and speak make flagrantly apparent."

This defective equipment Dr. Hutchins holds to be an especially grave menace at this time. "We confront our difficulties today," he says, "with little real assistance from our education * * * Our people have little knowledge and much opinion. They do not suspect that there is a difference between the two. The fundamental questions of human life and human society they have never faced. They would not know how to go about trying to face them."

Space is not here available to discuss these judgments. Naturally they reflect different viewpoints and discuss distinct problems. But both cut to the heart of our educational effort, i.e., to produce citizens competent to run a democracy and at the same time competent each in his respective job. If it be true that we fail on both these counts, just what have we for the time and the wealth that we pour into educational effort?

Willard Chevalier

ENGINEERING NEWS-RECORD

Published every Thursday. Vol. 119, No. 17. Price 25c per copy. Subscription, domestic, Canada, Mexico, Central and South American countries, $5 per year. All other countries, $9 a year or 36 shillings. Entered as second class matter October 29, 1936, at the Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C.

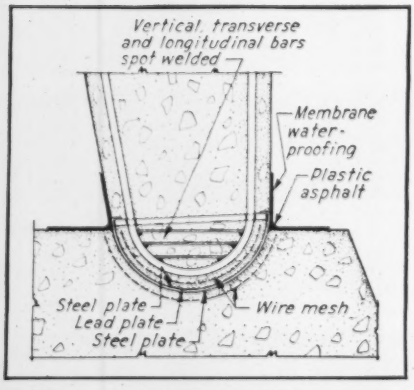
Copyright 1937 by McGRAW-HILL PUBLISHING COMPANY, Inc.

Editorial and Executive Offices: 330 West 42d St., New York. Publication Office: 99-129 N. Broadway, Albany, N. Y. Branch Offices: 520 N. Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

JAMES H. McGRAW, JR., President HOWARD EHRLICH, Exec. Vice President JAMES H. McGRAW, Honorary Chairman
WILLARD CHEVALIER, Vice President B. R. PUTNAM, Treasurer D. C. McGRAW, Secretary A. W. MORRISON, Circulation Manager

It's the World's Widest RIGID FRAME CONCRETE BRIDGE

Because of its rigid frame design the 68-ft. clear span required a center thickness of only 3 ft.



Hinged joint at footing, designed to allow free rotation.

Macy Street bridge, soon to carry trains entering Los Angeles Union Station, has a clear span of 68 ft. and a deck width of 505 ft.

Its width sets a record, but the advantages that dictated the choice of a rigid frame are the same as for hundreds of other rigid frame concrete railway and highway bridges—

- Shallow deck—lowers overpass, raises underpass; reduces excavation, fill and drainage cost.
- Monolithic construction—eliminates bridge seats, simplifies structure; reduces maintenance cost, increases service life.
- Traffic safety—clear spans up to 100 ft. or more economical for railroad or highway loading.

For beauty and economy design your next grade separation or stream crossing as a rigid frame concrete bridge. Have you the booklet, *"Analysis of Rigid Frame Concrete Bridges"?* Free on request.

PORTLAND CEMENT ASSOCIATION

Dept. 10c-17, 33 West Grand Avenue, Chicago, Illinois

· ENGINEERING NEWS-RECORD ·

McGRAW-HILL PUBLISHING COMPANY, INC.

WILLARD CHEVALIER, *Vice-President*

Editorial and Executive Offices: 330 West 42nd Street, New York . Publication Office: 99-129 North Broadway, Albany, N. Y.

F. E. SCHMITT, *Editor* ALBERT E. PAXTON, *Manager*

Copyright 1937

VOL. 119 *OCTOBER 21, 1937* NO. 17

THIS WEEK AND NEXT

THE LOCATION of Chickamauga Dam was fixed by navigation requirements within a limited section of the river where foundation conditions were very unsatisfactory. The story of why the dam was located where it is is told in this issue. In subsequent issues the foundation problems introduced will be described.

Absorbed in grade separation work, engineers of the Illinois state bridge department were surprised one morning to find a radio tower job coming across their drawing boards. Turning talents to this new job, they developed specifications and a design and then, proving again they were good engineers, junked their design when a bidder offered a more efficient one.

Dean H. T. Heald of Armour Tech tells of the use of precast reinforced concrete slabs on cast-in-place beams on page 671.

What is believed to be the longest continuous steel deck girder in this country, three spans of 137, 200 and 137 ft., is under construction in Frankfort, Ky.

Following a news story in last week's issue, a more complete report of the Atlanta public works convention is now brought forth. Personnel problems as well as physical operation problems were discussed.

In order to light a road economically the surface must have the proper characteristics. Surface design is stressed in the fifth of News-Record's *highway lighting series.*

Returning Canada's hospitality of another year, the American Society of Civil Engineers had the Engineering Institute of Canada as guest in a joint meeting week before last.

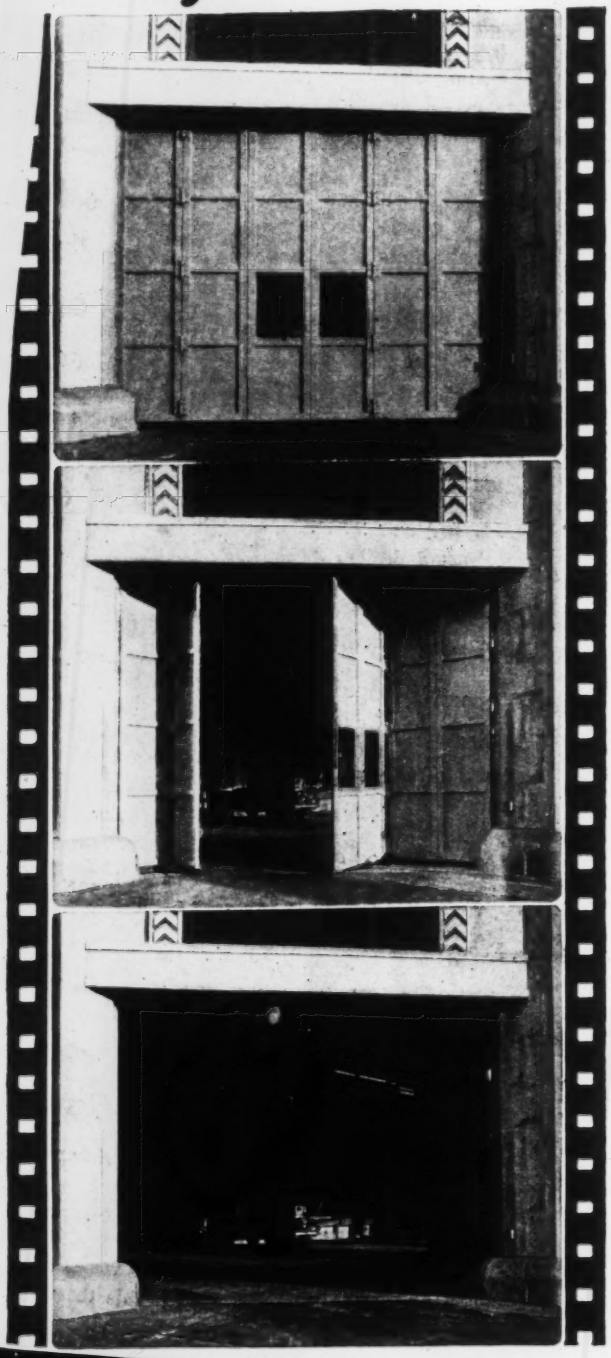
NEXT WEEK—Low cost figures on grading have been established by four large electric draglines operating on the 59-mile canal of the Kendrick irrigation project in Wyoming.

		PAGE
News of the Week		653, 689
Reader Comment		660
Editorials		662
Pictures in the News		664
Bad Rock Limits Dam Location		665
Elements of Chickamauga Dam (*Dam construction, Foundations, Flood control, Navigation*)	LEE G. WARREN	667
Radio Towers for Illinois Police (*Structures, Unit stresses, Wind design, Erection, Painting*)	A. BENESCH	669
Precast Reinforced Concrete Slabs (*Poured-in-place beams, Pressed steel forms*)	H. T. HEALD	671
Kentucky Builds a Record Bridge (*Continuous steel girders, Design, Concrete deck*)	E. D. SMITH	672
Beam Deflections Without Integrating	K. HAJNAL-KONYI	673
Atlanta Public Works Meeting (*Municipal personnel, planning and operating problems*)		675
Designing Roads for Lighting (*Surface requisites, Economics*)	C. A. B. HALVORSON	678
Civil Engineers Meet in Boston (*Soil mechanics, Flood control, Public works, Waterways*)		685
Unit Prices		692
New Aids to the Constructor	*Adv.page*	30
Construction Reports	*Adv.page*	33

PLACING of the first concrete in the foundation of Chickamauga Dam is shown on the cover this week. The crane is just moving into position beside the concrete train. At the left is the wall of the navigation lock built as the first stage of the development.

Number of copies of this issue printed: 29,529

They wanted a door that would



OPEN IN 5 SECONDS!

. . . AND THE Chicago concern that specified that "door-speed" demanded *"speed with safety"* . . . for heavy traffic rolls in and out of the building continuously.

TRUSCON met every specification . . . exactly. The 18′-8″ x 14′-2½″ vertical fold door has a safety feature which stops the door instantly upon impact with a truck or person passing through before the door is completely opened or closed. Rubber weather-strips at bottom of door insure protection against rain and snow when the door is closed. Speedy opening and closing of the door protects workmen from winter's frigid blasts. Wheel guards flank the door on both sides and do not interfere with its operation.

You may never encounter similar requirements. The point is this: that irrespective of complications in your door requirements . . . you can turn to TRUSCON for cooperation toward a quick and practical solution. TRUSCON Door Engineers are experienced in all door problems regardless of type or size. That experience is YOURS when you want it.

TRUSCON STEEL COMPANY
YOUNGSTOWN . . . . OHIO

THE WEEK'S EVENTS

Examiners Meet In Scranton

National Bureau of Registration discussed in N.C.S.B.E.E. sessions

Prof. S. H. Graf, director of engineering research at Oregon State College, was elected president of the National Council of State Boards of Engineering Examiners in a meeting of that group at Scranton, Pa., Oct. 11-13. Professor Graf was vice-president during the preceding year. A highlight of the meeting was an address by Willard Chevalier, vice president of the McGraw-Hill Publishing Co., in which he challenged the attempts of technical groups to call engineering a profession.

Principal business of the meeting included discussion of a report of the National Bureau of Registration Committee, and changes in the constitution and by-laws. Wednesday, the last day of the meeting, was devoted to a trip which included the International Correspondence School, Marvine Colliery and the Scranton Lace Co. mills. After the Tuesday afternoon business session, a visit was made to the Tunkhannock Viaduct of the Lackawanna Railroad near Nicholson, Pa.

Officers elected in addition to Professor Graf are: Charles F. Scott, Yale University, vice-president; J. O. Kemmerman, Rapid City, S. D., director of the Central zone; C. E. Meyers, Philadelphia, Pa., director of the Northeast zone. Other officers are Prof. J. S. Dodds, Ames, Iowa, past president; K. C. Wright, Salt Lake City, Utah, director of the Western zone; Prof. C. L. Mann, Raleigh, N. C., director of the Southern zone; T. Keith Legare, Columbia, S. C., executive secretary. Professor Dodds was appointed representative to the Engineers Council for Professional Development, and Dean G. M. Butler, Tucson, Ariz., and Virgil M. Palmer of Rochester, N. Y., were named members of the committee on National Bureau of Engineering Registration.

In his speech at the banquet Monday night, Mr. Chevalier began by reminding his audience that he had been an early opponent of engineering registration, although he had been in the minority. He had claimed then that a "profession" could not be established by legal means, and that he did not think that an analogy with the medical and legal professions could be an accurate one. "The difficulty in applying the analogy lies in the fact that the doctor and the lawyer offer their services to the layman, who must trust

(*Continued on page 659*)

Mathieu Photo

SIX-STORY AFTERTHOUGHT

MAIN PORTION of the new federal office building and post office in downtown Manhattan, New York City, was opened early this month, but construction is still proceeding on a six-story extension. The building was originally designed to permit of a future addition of six upper stories, with the thought that construction would be postponed for some years. However, after the job had been cleaned up and preparations made for opening of the building, it was suddenly decided to go ahead with the six additional stories immediately, with the result shown above.

Opening of the new building will permit tearing down of the old post office in City Hall Park, which has long offended the aesthetically minded.

Works Staff Shifted In Canada

General shifting of district engineers is made in Department of Public Works

A considerable number of important staff changes have just been made by the Department of Public Works, Canada. The department is the oldest federal governmental body dealing with engineering work in the Dominion; originally it was charged with almost all federal engineering, but since some of its duties have been transferred to new departments formed especially to deal with them, its main functions today are concerned with works on navigable waters, excluding the few major ports. The department operates through district offices located at strategic points across the Dominion, each in charge of a district engineer. The recent changes concern some of the more important of these district offices.

Changes made

H. E. Miller, Senior Assistant Engineer in the Charlottetown office, P.E.I. is promoted to District Engineer in the same office, replacing A. M. Kirkpatrick, transferred.

Bruno Grandmont, District Engineer at Three Rivers, has been appointed District Engineer at Quebec City, to succeed A. G. Sabourin, transferred.

J. H. Landry, Senior Assistant Engineer in the Montreal office, has been promoted to be District Engineer of the same office in place of J. L. Dansereau, the present District Engineer, who has resigned.

J. L. Bisson, Senior Assistant Engineer in the Ottawa office, has been promoted to the District Engineer of the same office, replacing J. E. St. Laurent, who was recently appointed Chief Engineer of the St. Lawrence Ship Channel.

A. M. Kirkpatrick, District Engineer at Charlottetown, P.E.I., has been appointed District Engineer at Winnipeg for the three prairie provinces. He succeeds F. J. Goodspeed, transferred.

A. G. Sabourin, District Engineer at Quebec and F. J Goodspeed, District Engineer at Winnipeg have been transferred to Board of Engineers, Ottawa.

Fundamentals Stressed By Educators

Call for engineering citizenship, attack unsound mathematics, denounce federal control of power

With Gov. Geo. D. Aiken of Vermont and Chairman Arthur E. Morgan of the TVA on the program, the New England section of the Society for the Promotion of Engineering Education gathered 300 strong at Tufts College, Medford, Mass., on Oct. 9 to study various problems in engineering pedagogy and bring the public obligations of engineers into sharper focus. Conferences on drawing, electrical engineering, mathematics and mechanics featured the morning session under the respective leaderships of Prof. E. F. Tozer, Northeastern University; Prof. W. B. Hall, Rhode Island State College; Prof. H. B. Phillips, Massachusetts Institute of Technology; and Prof. J. P. Den Hartog, Harvard University. The general engineering session was held under the chairmanship of Dr. C. S. Ell, Northeastern University.

Flood compacts

Gov. Aiken discussed "The Political Aspects of Flood Control in New England," reviewing the co-operative work leading to the framing of the interstate flood control compact for the Connecticut Valley; its submission to the War Department for acceptability; and its ratification by the legislatures of Vermont, New Hampshire, Massachusetts and Connecticut.

After the resolution which would have given Congressional approval to the compact was introduced, the Administration, acting on the advice of the Federal Power Commission, refused to approve the compact on the ground that the states had reserved to themselves rights of water storage, a possible power development, and title to the property. Action has thus been blocked. Gov. Aiken, asserting that he held no brief for private utilities and favored strictest regulation, emphasized the instant and practically unanimous New England opposition to the Brown-Casey resolution in Congress which followed introduction of the compact. This authorized a compact at the price of transferring all reservoir, power and storage sites to the federal government and further provided that the War Department be authorized to take from any state without their consent and with or without recompense, any dam sites on Connecticut river tributaries within those states. He declared that the scheme indicates a tendency on the part of the government to disregard its obligations to the states, indicating a state of mind in which the government "can change the rules in the last half of the ninth inning." Gov. Aiken pointed out that the compact shows the practicability of interstate co-operation and questioned the constitutionality of the Brown-Casey resolution.

Dr. Morgan made an eloquent plea for engineering citizenship, integrity in professional careers devoted to public service, and adequate self-preparation to fit the engineer to stand against political exploitation and unsound recommendations involving the spending of public money. Expanding governmental influence throughout the world challenges the engineer to render high-minded and independent service in his day, the speaker asserted.

Speaking on the topic "Soiled Mechanics," Prof. Hardy Cross, Yale, emphasized the need in engineering education to stand fast for fundamentals, or, as he declared, to the principle of pure mechanics, statics, geometry, and the properties of materials as related to applied forces. He held that too many diversions have entered the discussion of mechanics, producing a "soiled" mechanics cluttered with confusing and elaborate terminology, resulting in courses easy to teach and too easy to learn. Perverted techniques abound, Prof. Cross said; false deductions often permeate texts and even play an important part in requirements for economical use of material.

R. P. Kroon, Westinghouse experimental division engineer, cited the advances of the past 20 years in applied mechanics, notably in the study of vibration in ships, large turbo-generators and airplane propellers. He stressed the dependence of industry upon engineers trained in the college to apply fundamentals to problems of the field.

Authenticated News

DUTCH DOUBLE DECKER

THE PROBLEM of facilitating and protecting pedestrian traffic through the new Justus van Effenstraat housing development in a congested section of Rotterdam, Holland, has been solved by construction of an elevated highway two stories above the street.

Bicycles and delivery carts are raised to the elevated street by an elevator, and stairways are provided for pedestrians.

Three miles of these double decker streets have already been built in the city and they have proved so successful that it is planned to erect more in the near future.

• • •

Pittsburgh Engineers Union Explains Shift to C.I.O.

The action of the Pittsburgh local of the International Federation of Technical Engineers, Architects and Draftsmen's Unions, A.F. of L., in seceding from that group and joining the Federation of Architects, Engineers, Chemists and Technicians, C.I.O., which was announced at the annual convention of the F.A.E.C.T. (*ENR*, Oct. 14, 1937, p. 618), was taken because, although the local had grown since its affiliation last February with the A.F. of L., "further progress was blocked by the apathy and inactivity of the international executive committee of this A.F. of L. union," according to a statement issued by Max Aber, executive secretary of the local.

In his statement explaining the reasons for the move which has added more than 400 to the membership of the F.A.E.C.T., Mr. Aber said that "the September convention [of the I.F.T.E.A.D.U.] brought matters to a head, because every resolution introduced to stimulate organization and growth was defeated. . . . All representation on the executive committee was denied the locals . . . which have members in private industry. These locals represent about 75 per cent of the total membership.

"On the other hand, the F.A.E.C.T. is in the midst of a wholehearted campaign to organize technical workers in private industry and government offices. . . . A charter from the F.A.E.C.T. has been applied for, and its reception will mark the start of a major organizing campaign in Pittsburgh."

THE CURRENT TREND

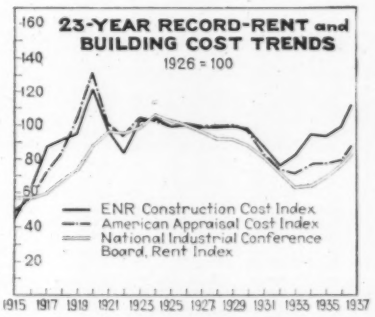
This week's news of contract volume and construction cost factors

Construction Costs Level Off

Rent trend moves steadily up, lagging behind construction cost rise but not seriously out of line

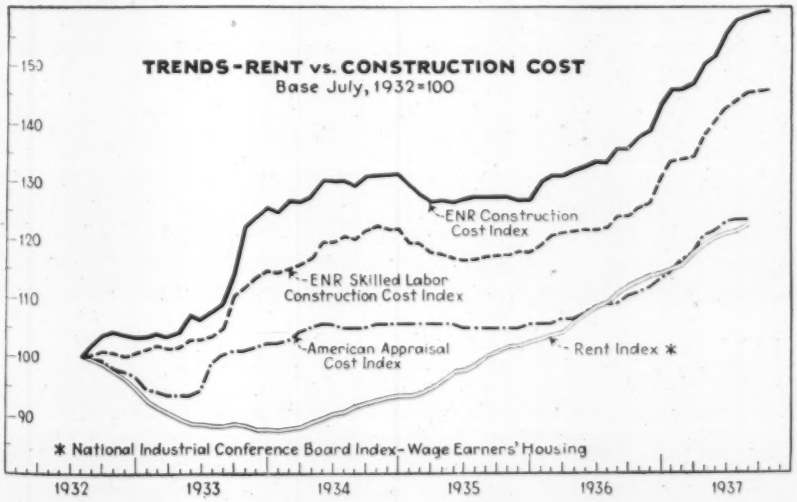
Over a period of 23 years rent has moved in a fairly similar trend to that of construction costs. The rent movement is slower, lags a year and is not as subject to sharp up or down minor variation. The accompanying chart compares the rent trend with both the *Engineering News-Record* Construction Cost Index and the American Appraisal Building Cost Index.

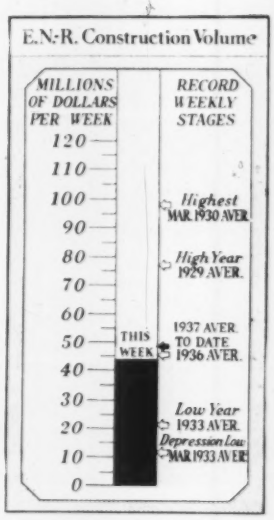
Compared with the American Appraisal Building Cost Index Trend the rent index has overtaken the building cost trend and is rising at about the same rate. This is not so true compared with the *ENR* construction cost trend. The *Engineering News-Record* Construction Cost Index since 1932 and the American Appraisal Index have separated widely. For example, in June *ENR* Construction Cost Index was 15 per cent higher than its 1929 average, American Appraisal index was 10 per cent lower. The Aberthaw and Turner Indices were 6 per cent and 5 per cent higher respectively. The *ENR* Construction Cost Index uses common labor which predominates in general construction and which has increased its wage rate average since 1932 much faster than has skilled labor. To apply specifically to building cost trends the skilled wage trend should be substituted for the common, which gives the *ENR* Skilled Labor Construction Cost trend curve shown in the chart below. In June it was 4½ per cent higher than the 1929 average, agreeing substantially with the Aberthaw and Turner ratios.



On the basis of these figures the construction cost rise appears to be slightly ahead of the rent trend but not seriously out of line.

Construction cost index figures show a leveling-off trend. The *News-Record* Cost Index rise has slowed down from an average increase of 3 points per month during the first seven months to 1.2 from July to August, 1.0 in September and 0.6 in October. The American Appraisal Index has similarly flattened and the Aberthaw Index for the 3rd quarter shows a 1.7 drop from 2nd quarter value.





THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Oct. 22 1936	Oct. 14 1937	Oct. 21 1937
Federal	$3,675	$1,983	$3,079
State & Municipal	28,579	15,077	15,786
Total public	$32,254	$17,060	$18,865
Total private	10,866	17,099	25,081
TOTALS	$43,120	$34,159	$43,946

Cumulative	
1937 (42 weeks)	$2,012,943
1936 (43 weeks)	$1,912,952

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative. 1936 43 Wks.	1937 42 Wks.
NON-FEDERAL	$762,585	$1,320,282
State & mun. bonds	418,000	423,621
Corporate securities	204,359	488,596
PWA loans, grants	115,228	178,126
RFC loans	24,998	29,939
Fed. aid for highways		200,000
FEDERAL	$691,237	$746,223
TOTAL CAPITAL	$1,453,822	$2,066,505

ENR INDEX VALUES

Index Base	1913	1926
Construction Cost (Oct.)	244.55	117.55
Construction Volume (Sept.)	148	65

Business Briefs

CONCRETE PAVEMENT YARDAGE for roads in September dropped 13 per cent below the volume of September, 1936. Street yardage fell 37 per cent, but alleys gained 40 per cent over last year. For the 9-month's period, a gain of 5 per cent over 1936 for all three classes is reported by the Portland Cement Association. Reported totals are:

Square Yards Awarded	Sept., '37	9 mo., '37	9 mo., '36
Roads	4,499,085	32,643,736	29,575,034
Streets	1,509,269	10,617,377	11,802,372
Alleys	50,339	429,705	290,031
Total	6,058,693	43,690,818	41,667,437

Start Permanent Work On Central Valley

Clearing of right-of-way difficulties permits start on Contra Costa canal contract

A federal court order permitting the Bureau of Reclamation to take possession in eminent domain of land needed for the right-of-way of the Contra Costa canal of the Central Valley project has cleared the way for start of work on the first contract on the canal, which has been held up since March 23 by land acquisition difficulties. Start of work on the 4-mile section, contract for which is held by Haas, Doughty & Jones and Marshall & Stacy, San Francisco, will mark the first construction of permanent work on the Central Valley project.

The canal contract involves earthwork and structures for a broad tidewater section of canal extending from the Rock Slough intake in Knightsen on the lower San Joaquin River to the first pumping plant near Oakley.

Award of the contract for $103,000, lowest bid of 25 proposals received March 1, was approved by Secretary Ickes on March 23.

Advertisements will soon be issued for construction of the next 8 miles of the canal, from the end of the present contract to the south boundary of the Los Medanos oil storage reservoir near Pittsburgh.

Ultimately the Contra Costa canal will extend from Rock Slough westerly about 40 miles to a small reservoir above Martinez, delivering fresh water to an industrial district along the south shore of Suisun Bay and providing irrigation supply for an adjacent area of orchards and field crops as well as a domestic water supply for five municipalities.

• • •

Highway Research Board Expands Meeting

The seventeenth annual meeting of the Highway Research Board of the National Research Council will last for four days instead of for the two days that have been sufficient in former years. The board will meet in Washington, D. C. on Nov. 30-Dec. 3. A large part of the time will be devoted to open departmental meetings on economics, design, materials of construction, soils investigation, and roadside development.

The department of soils investigation will hold an open meeting Nov. 30 which will last all day. At the opening board session the next day, papers and reports relating to soil and to maintenance will be presented in the morning and the afternoon will be devoted to meetings on materials of construction and roadside development.

Thursday's meetings will include a general session in the morning on finance, materials of construction, and roadside developments, and one session in the afternoon on highway safety. Friday will be devoted to design and economics, including a common general session in the morning and departmental meetings in the afternoon.

Arthur Tuttle Resigns As State PWA Director

Arthur S. Tuttle, New York state director of public works for the Public Works Administration, has resigned, effective Oct. 31, at which time his office will be absorbed in a new division office being set up by the PWA as part of its plan to reduce and consolidate its field forces. In handing his resignation to Secretary Ickes, Mr. Tuttle offered to continue as project engineer for the Queens-Midtown Tunnel at New York until such time as he could be relieved conveniently, if the Secretary so desires.

Mr. Tuttle was drafted for service as state engineer for the PWA in 1933, shortly after he had resigned as consulting engineer to the board of estimate of the city of New York, terminating 48 years' continuous service with the city. Mr. Tuttle continued as state engineer for two years and then as acting state director and state director.

On Oct. 14 Mr. Tuttle announced that over fifty members of his staff would be dropped at the end of October as part of the reorganization plan.

Cement Inspection Tax Upheld in Florida

The Florida supreme court on Oct. 12 unanimously upheld a bill passed by the 1937 state legislature levying an inspection fee of three dollars a ton on cement brought into the state. The state highway department had refused to enforce the law and the Florida Portland Cement Co., sought and obtained from the Supreme Court an order compelling enforcement of the law.

The bill was attacked by the highway department primarily on the grounds of certain irregularities in its passage and also on the ground that the fee amounted to a tariff on interstate commerce and was prohibited by the Constitution.

In its decision, the court held that the irregularities in passage were not sufficient to void the bill and held further that the levy was for inspection purposes only. Although the federal government reserves all power over tariffs, the court held, it permits the states to lay imposts "which may be absolutely necessary for executing its inspection laws." The court held that the fee would have been unconstitutional if it had been levied to raise revenue for the state.

• • •

Purdue Builds Laboratory For Soil Mechanics

A modern research laboratory of soil mechanics is now under construction at Purdue University under the direction of P. C. Rutledge, newly appointed associate professor, who for the last 4 years has been associated with Prof. Arthur Casagrande at Harvard University. The new laboratory will embody many of the features of the soils mechanics laboratory at Harvard (*ENR* Dec. 5, 1935, p. 783) as well as a number of newly developed devices in soil testing equipment. Its research activities for the first 2 years will be confined to intensive studies of the consolidation characteristics of clays, to an attempt to develop more satisfactory apparatus for the determination of shear and to a study of soil problems in highway and airport engineering.

Beginning with the academic year 1938-39 instruction will be offered in soil mechanics, soil testing methods, methods of underground exploration for engineering purposes, seepage, ground water movement and the design of earth dams. A coordinated program is being prepared for students desiring to study for a degree of master of science in this field.

Straus Appointed Head Of Federal Housing

Nathan Straus has been appointed to be administrator of the U. S. Housing Authority set up by the last Congress under the terms of the Wagner housing bill. The appointment was announced Oct. 18. Mr. Straus is a member of the New York City Housing Authority and the author of a number of monographs on housing. He has been in business as a newspaper publisher and was for some years a state senator in New York State.

Since the passage of the housing act there has been much interest in the appointment as administrator, as offering a possible indication of the policy to be followed by the authority. Remarks of Secretary Ickes, under whose department the authority is placed, at the recent conference of mayors and housing administrators in Washington led to the belief that Howard R. Gray, head of the housing division of PWA, might be appointed. That appointment would probably have been unwelcome to many of the proponents of the bill, including Senator Wagner himself, who had originally opposed placing the housing authority under the Interior Department on the grounds that the PWA housing division, under Secretary Ickes, had developed its program too slowly and had unduly centralized authority in Washington. Mr. Straus' candidacy is understood to have been pushed by those who opposed such centralization.

• • •

Keystone Dam Bids Called Soon

The Central Nebraska Public Power and Irrigation District expects to advertise about Dec. 1 for bids for the major portion of Keystone dam on the North Platte River near Keystone, Neb. Outlet work and spillway structures and the steel sheet piling cutoff wall for the dam are now under construction.

Major elements of the structure are a hydraulic fill dam about 160 ft. high and 10,000 ft. long and a loose fill dike with compacted earth core about 30-ft. high and 5,800 ft. long.

Outer material for the main dam will be pumped from the river bed, and the impermeable core material will be obtained by sluicing from high land nearby. The upstream face will be protected with brick or rock riprap.

Also involved is relocation of about 35 miles of single track railroad, about 35 miles of pipe line, and about 100 miles of gravel highways.

Construction of a wave wall, guard rail, a roadway across the top of the dam, and construction of an emergency spillway will be left to a later contract.

• • •

Denver Water Diversion Approved by Court

Diversion of western slope water for the city of Denver through the Moffat Tunnel was approved by a district court decision at Hot Sulphur Springs, Colo., which dated diversion water rights back to July, 1921, giving a clear title to water needed for diversion to the eastern slope. The decision is expected also to speed the Grand Lakes diversion project.

Stating that the pre-dating of the water rights will give diversion projects priority over lower basin projects, city attorney Lindsey of Denver stated that "the whole diversion set-up is validated by the decree. . . . It means the water supply for Denver will be protected for many years to come, that Northern Colorado will receive additional water, and that the western slope will not suffer."

• • •

New England States Push For Compact Approval

No action directed toward immediate state activity in flood control independent of the federal government was taken at the New England governors flood control conference held in Hartford Oct. 11 at the invitation of Governor Cross of Connecticut. The delegates from the six New England states decided rather to push for ratification of the Connecticut Valley and the Merrimac Valley flood control compacts.

Another meeting is scheduled to be held early in November in advance of the special session of Congress. In the meanwhile, groups from each state will work to consolidate support for the compacts in their own Congressional districts.

The Connecticut Valley compact was ratified by the states of Connecticut, New Hampshire, Vermont and Massachusetts and submitted to Congress. It was favorably reported by the committees of both houses of Congress and could still be acted upon at the next session. The last Congress, however, refused to ratify the compact on the basis of opposition by the President and the Federal Power Commission. The power commission, in a report on the compacts, held that they jeopardized federal interests because they specifically reserve to the states all rights to power generated in connection with the flood control work.

New York Airport Cost Announced

Municipal Art Commission approves plans for modernizing North Beach field

The estimated cost of a proposed development by the city of New York of the North Beach airport was revealed as being nearly $15,000,000 when preliminary approval was granted by the Municipal Arts Commission to the airport building plan.

Central building of the project will be the $1,047,000 administration headquarters for land-plane operation. A two-story building with a broad observation platform circling the second story, the structure will house the field office staff, a general waiting room for the public, rest rooms for pilots, and space for airlines using the base. A parking field next to the building will also be adjacent to a boat basin opening on Flushing Bay.

Six land plane hangars, three on each side of the administration building, will each cost about $990,000.

A smaller administration building for seaplane activities, at the west end of the development, will cost about $545,000, but the two seaplane hangars will each cost $1,151,000. The partition walls of these buildings will be set in a radiating spoke pattern, so that if it is necessary to increase the width of any section to accommodate ships with larger wing spans it will only be necessary to extend the partitions.

The project involves construction of three runways, each one 4000 ft. long, and the placing of 15,000,000 cu.yd. of fill in the Rikers Island channel. It is proposed to place this fill by means of trucks operating over a temporary trestle from Rikers Island.

• • •

Desert Work Resumes On Colorado Aqueduct

Construction of concrete conduits on the desert section of the 392-mile Colorado River aqueduct was resumed Oct. 6. The present "open work" construction will see the completion of this type of work on the aqueduct. The main line is now more than three-fourths completed.

All canals and 84 miles of main aqueduct tunnels are already completed, and less than nine miles out of a total of 145 miles of conduits and siphons remain to be finished. Concreting of this remaining work was suspended during the summer months because of the desert heat.

LABOR NOTES

DOMINATING the labor news of the week was the possibility of unification of the A.F. of L. and the C.I.O. Leaders of C.I.O. unions, meeting in Atlantic City, N. J., voted on Oct. 12 to ask for a meeting with the A.F. of L. to consider means of unification. The C.I.O. proposal asked for a committee of 100 delegates each from the A.F. of L. and the C.I.O. William Green, president of the A.F. of L., immediately attacked the proposal as insincere but handed it for action to the executive council of the federation, where it was accepted in principle, although the council rejected as impractical the proposal for committees of 100 and instead offered to enlarge its standing committee of three for negotiation with the C.I.O. to "a reasonable size." The C.I.O. thereupon named a committee of ten to meet with representatives of the A.F. of L. on Oct. 25 to arrange a unification conference. The original C.I.O. offer for a conference emphasized that in any unification arrangement there could be no compromise with the principle of industrial unionism.

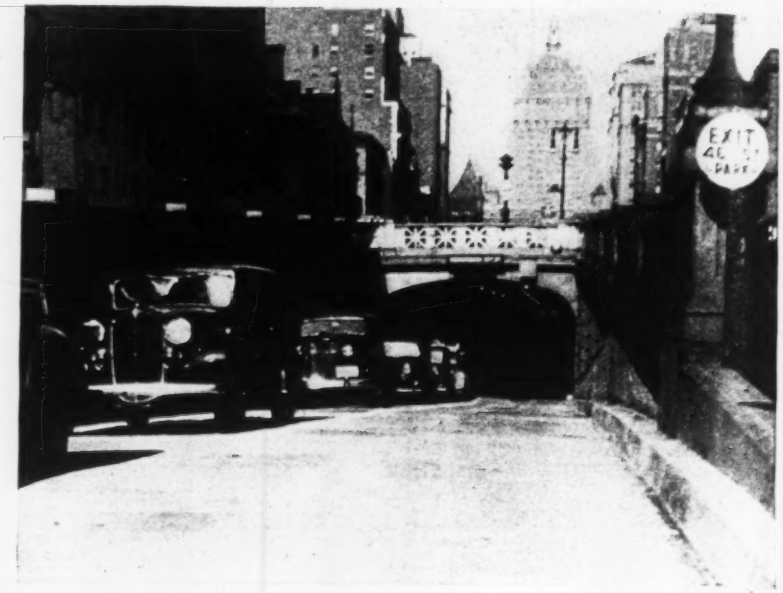
While these peace moves were going on, the A.F. of L. continued to organize itself for its "war" against the C.I.O., and the C.I.O. itself took steps toward forming a permanent organization as an independent body. The convention of the A.F. of L. adopted the proposals of the executive council (*ENR*, Oct. 7, 1937, p. 582) empowering the executives to expel the suspended C.I.O. unions and granting broad powers of disciplinary action against state and local bodies which might fail in zeal against the industrial unions.

As the convention closed, the executive council directed President Green to order the Colorado Federation of Labor to expel all C.I.O. unions. Outside the convention too, the A.F. of L. moved against its rival as the Boca dam project on the Little Truckee River in California was placed on the unfair list by the Nevada state building trades council, and in Portland, Oregon a threat of a general tie-up of all A.F. of L. unions developed as a part of an attempt by the carpenters union there to regain control of the lumber workers who recently seceded from that union to join the C.I.O.

Meanwhile the union leaders in Atlantic City voted authority to the executives of the C.I.O. to call a national convention to organize the C.I.O. permanently under a constitution.

Other action at the C.I.O. meeting included a resolution formally affirming that "The C.I.O. expresses its firm policy as being one committed to determined adherence to its contract obligations and responsibilities." Other resolutions adopted call for legislation licensing all interstate industries, for federal wage and hour legislation, appropriation of sufficient funds for WPA and PWA to assure jobs for all unemployed, and extension of the social security program. Resolutions also propose that legislation be adopted in the various states establishing state labor relations boards and preventing courts from issuing injunctions in labor disputes, preventing evictions of unemployed persons or strikers, and payment by private corporations of deputy sheriffs.

With two labor conventions in progress, the National Labor Relations Board found itself in the perhaps not unwelcome position of being fired at from both sides. After the resounding attack on the board and the calls for revision of the Labor Relations Act which were made by the A.F. of L. executive (*ENR*, Oct. 7, 1937, p. 582), and echoed in resolutions adopted on the floor of the convention, came an attack by the C.I.O. on a recent NRLB decision (*ENR*, Oct. 14, 1937, p. 620) which permitted minority craft groups in a plant predominantly organized on industrial lines to be represented by craft unions. C.I.O. asserted that "permitting craft organizations to seep into mass production and basic industries is directly opposed to the interests of the overwhelming number of workers in such industries." Answering both attacks, the board issued a statement pointing out that as long as the split in the labor movement continued, board decisions cannot please both groups and asserting that the fact that the board is carrying out the intention



NEW USE FOR AN OLD TUNNEL

PARK AVENUE TUNNEL, running under Park Avenue in Manhattan, New York City from 33d to 40th Sts., was opened to automobile traffic early this month, thus putting it to the third different use which it has served during its history. New York Central steam trains once used it, in the days before the New York Central trucks were covered over, and the tunnel was later used for street cars operating on the Madison Avenue line.

In its present incarnation the tunnel has two 10-ft. traffic lanes and will be used for two-way traffic at first, though traffic lights have been so installed that it may be used later for one-way traffic. The tunnel is equipped with an $18,000 ventilating system. Exhaust fans controlled automatically by carbon monoxide detectors expel fumes in the tunnel when the carbon monoxide concentration reaches two parts in 10,000. Of two emergency exits, one, at 38th St., was formerly used as a trolley station, and a new one was installed at 36th St.

Rehabilitation of the tunnel was carried out as a WPA project at a cost of about $250,000, not including the ventilation system which was purchased by the city.

of the law, to protect the right of workers to organize, is evidenced by the fact that 4,000,000 men have been added to the ranks of organized labor in the past year.

The boycott declared by the International Brotherhood of Electrical Workers, A.F. of L., against the use on construction work of electrical goods produced by C.I.O. labor (*ENR*, Aug. 26, 1937, p. 333) has given rise to an injunction suit in the federal court at New York City brought against the union by 14 manufacturers, members of the National Electrical Manufacturers Association. The manufacturers assert that Local No. 3 of the I.B.E.W., in agreements with contractors in the New York City metropolitan area, have stipulated that the contractors use only equipment made by members of the I.B.E.W. The manufacturers contend that they are required by the Wagner act to recognize whatever unions their employees choose and that Local No. 3's action constitutes a violation of the Sherman anti-trust act. Pointing out that the agreements in question date back to February, 1935, before the C.I.O. issue arose, union representatives hold that the contracts are only an ordinary exercise of the union's right to protect itself against non-union products.

Nearly 82 per cent of building trades workers have full time working hours of 40 or less per week, the U. S. Bureau of Labor Statistics announced Oct. 9 on the basis of a survey made during the fall of 1936 covering more than 186,000 building trades workers. Of the union employees, 96 per cent had a full time working week of 40 hours or less, while of non-union employees 51 per cent had such a work week. Considerable variation was found in different parts of the country: in New England, Middle Atlantic, East-North-Central, and Pacific regions, the week of 40 hours or less applied to 80 to 93 per cent of the workers covered. In the West-North-Central and East-South-Central regions to 78 per cent, to 70 per cent of those in the South Atlantic region, 67 per cent of those in the mountain region, and 58 per cent of those in the West-South-Central region.

A four day strike of workers on the construction of the substructure of the Baton Rouge bridge across the Mississippi River at Baton Rouge, La., won union recognition, an increase of about 22 per cent in rate of pay for skilled workers and an agreement to utilize primarily local labor. Two hundred and fifty employees of the Kansas City Bridge Co., working on the bridge proper, and 50 employees of the Uvalde Construction Co., working on the approaches, went on strike Oct. 10.

The agreement, negotiated with representatives of the A.F. of L., did not provide for a closed shop. It provided for a grievance committee and arbitration of disputes and allowed the contractors to employ 60 men other than local labor.

Wage rates established in the agreement provided $1.10 per hour for first-class tank workers, riggers, and hoisting engineers, 90 cents an hour for welders and caulkers, 85 cents for pile drivers, carpenters, form setters and reinforcing rodmen, 75 cents for mechanics and mixer operators, and a rate of 40 cents an hour for common labor on the job.

• • •

Engineer Examiners Meet in Scranton

(*Continued from page 653*)

more or less blindly in the man with the shingle, whereas the engineer's influence is indirect because he is retained by those who can check him . . . and protect themselves from the charlatan."

Because of this lack of a check in the medical and legal occupations, Colonel Chevalier stated that a "profession" must be relied upon to maintain high standards and back up statutes which might otherwise be hollow. It was his belief that statutory groups such as the N.C.S.B.E.E. should remain independent of ethic-promoting organizations such as American Society of Civil Engineers, and that in this way attainment of some professional status might some day be possible.

In its business sessions the meeting approved a plan of the committee on the National Bureau of Engineering Registration for procedure and requirements for the bureau. The committee's report also stated that the bureau had accepted 78 applications for the certificate of qualification during the past year. Of this number, 56 were approved, 2 rejected, and 20 are pending.

In his annual report, T. Keith Legare stated that 3 states, Georgia, Nebraska and Texas, have adopted registration laws in the past year and have become members of the National Council, bringing the number of members to 38. There are now about 53,000 registered professional engineers and land surveyors in the United States, according to the report.

Next year's meeting will be held in Des Moines, Iowa, in October. 53 men representing 30 states attended the Scranton meeting, and 10 national engineering groups were represented.

WPA Will Refuse Projects For Untreated Sewage

The Works Progress Administration has adopted the policy of refusing to approve any further municipal projects for the construction, reconstruction, repair, or extension of sanitary sewers discharging into lakes or streams unless the sewage is treated in a disposal plant, or unless such treatment is contemplated in the near future.

The last requirement is not closely defined, and each case will be considered on its merits. In general, it may be assumed that WPA will definitely refuse to participate in sanitary projects adding to the pollution load of lakes and streams unless it is satisfied that the pollution will soon be remedied and that plans for treatment works are either included in the pending project or sufficiently advanced to provide reasonable assurance that construction will soon be started.

All WPA state directors have been notified of the new policy, which is believed to have originated in the White House although no official statement to that effect has been issued.

• • •

Chicago Approves Chapters Of New Building Code

Passage on Oct. 13 by the Chicago City Council of the first six chapters of a new building code marks the beginning of action on the part of that city on revisions which have been in the hands of experts for ten years.

Typographic errors in formulas for pile driving in the chapters published in Council proceedings which were reported in *ENR* Sept. 23, p. 512 were corrected prior to passage. On p. 513, at the bottom of the first column the formula for a double-acting hammer should read

$$P = \frac{2\,h\,(Am + W)}{S + 0.1 \text{ in.}}$$

The formula and text following in the second column should read

$$P = \frac{2\,E}{S\left(1 + \frac{0.3\,w}{W}\right)}$$

in which E equals the energy in ft. lb., which is Wh for a single-acting hammer and $h\,(Am + W)$ for a double acting hammer; w equals the weight of the pile and W equals the weight of the moving parts.

Also on Oct. 13 the building committee recommended three more chapters (on masonry construction, on steel and metal construction and on chimneys) which the city council ordered "deferred and published."

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Large Exhibition Building

Sir: On page 413 of your issue of Sept. 9, describing London's new Earl's Court exhibition center, you make the very interesting statement that the "main floor of the exposition center constitutes the largest area of concrete without expansion joints ever laid down." You also state that the steel roof trusses which span the main hall are the longest ever erected. Just how large is this floor, and just how long are these trusses?

Buffalo, N. Y. CHARLES P. LAKE

The floor area referred to by Mr. Lake is 250x400 ft. The roof trusses have a span of 250 ft. so that the statement that they are the "longest" applies only to Great Britain. In this country the Glenn Martin aircraft factory in Baltimore and a livestock exhibition building at San Francisco, to mention two recent structures, have trusses with a 300-ft. span.

The Earl's Court exhibition center in the West End of London is a triangular shaped reinforced concrete building covering nine acres. Two of its sides are each 700 ft. long while the third is 900 ft. long. It is built over four railway tunnels, two double-track and two single-track. The main hall of the building is spanned at a height of 150 ft. above floor by seven 250 ft. steel trusses spaced 50 ft. on centers. Each of these trusses weighs 83 tons and carries a 200-ton dead load and 150-ton live load in addition to 13½ tons of suspended load distributed among nine panel points.

The existence of the railway lines under the building necessitated construction of 60 very heavy reinforced concrete beams which carry the building columns above the tracks. The largest of these beams has a simple span of 105 ft., a width of 18 ft. and a depth of 9 ft. Main reinforcement consists of 336 2-in. diameter round bars at the top and an equal number at the bottom. Stirrups for this beam consist of 5/8-in. and 7/16-in. rods. The hinge supports for these beams were made by bringing the reinforcement of the carrying columns together in a line at right angles to the beam and on the centerline of the columns and then fanning the reinforcement out into the portion of the beam above. A narrow collar of concrete was formed around the bars at the top of the column, and the remaining width of the column on each side was filled with asphalt up to the level of the underside of the beam.

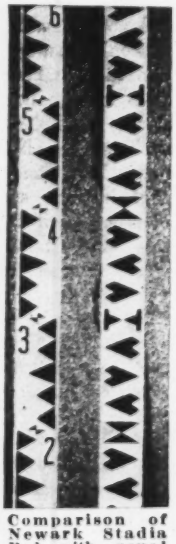
EDITOR

• •

Fast Reading Stadia Rod

Sir: A "Design for Stadia Rod" by Gordon Dinsmoor in the July 8, 1937, issue prompts me to send you a picture and description of a stadia rod I designed some years ago.

In 1930 the Newark College of Engineering made up in its shop a number of stadia rods of 12-ft. length. As these rods were to be carried by students in their cars they were hinged at the 6-ft. point. A removable and reversible rib 3 to 4 ft. long is fastened at the back of the rod to hold the two halves rigidly open.



Comparison of Newark Stadia Rod with usual fish-tail rod.

The rods were made from 1x5-in. stock and were given two coats of flat white paint. Then the designs as well as all numbers were painted black and the whole given a coat of clear varnish. On several rods a sawtooth pattern was devised so that the 1, 3, 5, 7, and 9-tenth points were at the apex of the black triangles, the 5-tenth points being accentuated. Each foot of pattern reverses from side to side on the rod.

The accompanying pictures show the Newark rod alongside a conventional stadia rod with fishtail pattern. The students like the Newark rod best and make fewer mistakes in reading it. In a test on a measured line with several observers reading stadia rods with different patterns, the Newark rod was faster for equal accuracy in reading. Working drawings of the rod will be furnished upon request.

WILLIAM S. LA LONDE, JR.
Associate Professor of Civil Engineering
Newark, N. J.
Sept. 20 1937

• • •

How Stiff Is a Beam?

Sir: Referring to the interesting problem in the *Engineering News-Record* of Sept. 23, p. 525, I hope you will find the following analysis of value to the readers of your column.

Assumptions: E = Modulus of Elasticity 30,000,000 for steel, 15,000,000 for cast-iron. f = Elastic limit 30,000 for steel, 15,000 for cast-iron.

$$M = \frac{Pl}{8}\ \text{(max.)} \qquad \text{Deflection} = \frac{Pl^3}{192EI}\ \text{(max.)}$$

Considering resulting fibre stresses under the given conditions, the cast-iron member will probably fail, while the steel member will reach its elastic limit.

$$\text{Since } M = 500 \times \frac{40}{8} = 2500 \text{ in.-lb.}$$

$$f = \frac{2500 \times 6}{2 \times (1\frac{1}{2})^3} = 30{,}000 \text{ (lb. per sq. in.)}$$

In order to answer the question—"Which will deflect the most under the given conditions?" and consequently the general question—"Will cast-iron or steel be stiffer?" intelligently, one must remember that although deflection is theoretically independent of the fibre stress in a beam of any section, no logical conclusions can be made without comparing the deflections of the two materials stressed within their respective elastic limits. These values cannot be exceeded according to the fundamental "straight line" variation of stress.

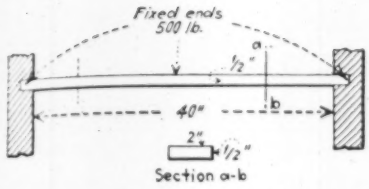
Analysis:

(1) Since $M = \frac{fI}{c}$; $I = \frac{Mc}{f}$

(2) and Deflection δ = (constant) $\times \frac{Pl^3}{EI}$: Let constant = K.

$$\delta = K.\frac{Pl^3}{EI}$$

(3) also $M = \frac{Pl}{8}$ beam fixed at both ends



Will cast iron or steel be stiffer?

(4) Substituting for M in eq. (1)

$$I = \frac{Pl \cdot c}{8f}$$

(5) Substituting for I in eq. (2) and cancelling

$$\delta = K \cdot \frac{87 \cdot 2f}{E \cdot c}$$

(6) Reducing equation (5) further, the deflection can be expressed in terms of the fibre stress, f, and the modulus of elasticity E, (all other terms being constant for any given condition).

Therefore δ = constant $\times \frac{f}{E}$

Remembering that the values of both f and E for cast-iron are approximately one-half those of steel, the comparative ratio $\frac{f}{E} = 1$.

Concluding:

Both materials will deflect the same amount, and have the same stiffness.

Note: Deflections producing unit stresses exceeding the elastic limit have no practical meaning and are not comparable.

Knoxville, Tenn. DEAN P. TSAGARIS
September 28, 1937 Engineer with TVA

Sir: With reference to the problem concerning the deflections of cast-iron and steel plates, I wish to submit the solution below. The tabulated deflections show that the steel deflects only one-half the amount that the cast-iron does.

Montreal, P. Q. LINDLEY SHECTOR
September 25, 1937

Wt. cast iron 450 /c.f. Modulus Elasticity $E = 15 \times 10^6$ lb. per sq. in. Modulus Rigidity $G = \frac{2}{5} E$.

Wt. steel 490 /c.f. Modulus Elasticity $E_s = 30 \times 10^6$ lb. per sq. in. Modulus Rigidity $G = \frac{2}{5} E_s$

Deflection	Cast-Iron	Steel
Due to dead wt. (Bending) $\frac{1}{384}\frac{wl^3}{EI}$	$\frac{1}{384} \times \frac{3.13 \times 122.8}{15 \times 10^6 \times \frac{1}{48}} \times 12^3 = 0.00553''$	$\frac{3.40}{3.13} \times \frac{15}{30} \times .00553 = .00300''$
Due to 500 lb. (Bending) $\frac{1}{192}\frac{Wl^3}{EI}$	$\frac{1}{192} \times \frac{500 \times 36.9}{15 \times 10^6 \times \frac{1}{48}} \times 12^3 = 0.53000''$	$\frac{1}{2} \times 0.530 = 0.2650''$
Due to 500 lb. (Shear) $\frac{3}{10}\frac{Wl}{Gbd}$	$\frac{3}{10} \times \frac{500 \times 3.33}{\frac{2}{5} \times 15 \times 10^6 \times 2 \times \frac{1}{2}} \times 12 = 0.000999''$	$\frac{1}{2} \times 0.000999 = 0.000499''$
	Total ..... 0.5365 inches	0.2685 inches

Sir: The maximum deflection (inverse of stiffness) of a beam of uniform cross section, fixed at both ends and concentrated load at center varies inversely as E, modulus of elasticity of material, or may be simply written

$$d_{Max.} = \text{constant} \times \frac{1}{E}$$

E for cast iron = 12,000,000 lb.
E for steel = 29,000,000 lb.

Therefore, a cast-iron beam will deflect more than a steel beam under the prescribed conditions.

Kansas City, Mo. S. L. KRECHEFSKY
September 29, 1937

Why "Sharp" Sand?

An engineer asks why many specifications call for "sharp sand." In his experience, he says, he has never seen a sand that could fairly be called sharp. Can the sand experts explain? Is sand by its origin necessarily composed of rounded grains?

The Professional Objective

Sir: Permit me to compliment you on your timely editorial entitled "Toward Useful Service" in the Sept. 16 issue.

As a very recent college graduate I am interested to note the attitude being assumed by the profession in regard to engineering students. Your question as to whether the beginner wishes to become an engineering craftsman is particularly significant. Coming at a time when engineers are more and more realizing the necessity of establishing themselves as a profession it may offer a partial solution to this problem. A man who has spent four years in specializing himself for some definite phase of engineering work is certainly more fitted to be admitted to a profession than the man who blindly groped his way while at college.

It would be well if engineering instructors would give serious thought to your editorial. Let them wisely counsel their students in order that the field of engineering, so fully devoted to human service, may truly be called a profession.

C. W. MUHLENBRUCH

New Kensington, Pa.
Sept 25, 1937.

Municipal Balance Sheets

Sir: The article in your issue of September 30th entitled "Charting a Safe Financial Course" is one which should be of interest to all engineers, not only those employed by municipalities but those who are citizens and residents.

I was greatly surprised some years ago at the reaction in financial circles when the Village of Scarsdale, N. Y., desiring to borrow money for capital expenditures, submitted a complete statement of its financial position, its assets and liabilities, its revenues and expenses. I was told at that time, some 5 or 6 years ago, that this was an innovation in proposals for municipal finance. Such a balance sheet and record should, of course, be prepared annually for a municipality as it is for a commercial organization, and should be a sine qua non for any new financing. Engineers might well, if occasion arises, advocate the submission of such a statement and see that it is in correct and understandable form.

The important point in all municipal finance is, of course, control of the funded debt. Current expenses can be raised or lowered to suit the times but the funded debt is remorseless, its requirements must be met on time or default and loss of credit ensues.

A yearly balance sheet properly prepared and control of the funded debt to the point where it can surely be met in times of depression and stress, are the fundamental elements of sound municipal finance. I suppose it is hardly necessary to add, in a statement which will be read mostly by engineers, that adequate and competent engineering advice may save much unwise expenditure.

New York, N. Y. FRED LAVIS
October 13, 1937

ENGINEERING NEWS-RECORD

Copyright 1937, by McGraw-Hill Publishing Company, Inc.

Volume 119, Number 17

Editor, F. E. SCHMITT · *Editorial Staff*, V. T. BOUGHTON
N. A. BOWERS, W. G. BOWMAN, W. W. DE BERARD
C. S. HILL, H. W. RICHARDSON, E. J. CLEARY

Editorial Offices at 330 West 42nd Street, New York

OCTOBER 21, 1937

IT WAS NO SURPRISE to those who have observed the rapid advance of soil and foundation study to find the subject taking the lion's share of attention at the Boston meeting of the Civil Engineers. With several hundred following the proceedings carefully throughout, soils outranked by 2 to 1 even the discussion of public-works policies before the economics division. The practical importance of the soil problems discussed proved to justify this strong interest. An outline of the newer engineering methods applied to levee and embankment construction, description of the conditions that called for a building foundation of unusual type, and interchange of experience on subsoil exploration by borings, were among the matters of timely importance included in the meeting. The discussions showed, fortunately, that the limitations and weaknesses of the new science are being realized more and more clearly. In all respects the discussion gave promise of continued progress in soil and foundation knowledge, progress whose ultimate extent cannot yet be foreseen.

Where Necessity Governs

BAD FOUNDATION CONDITIONS such as were encountered at the site of Chickamauga Dam would inevitably call for rejection of the site but for pressure of compelling reasons. Engineers have had too much sorry experience with insecure and cavernous substrata to accept foundation conditions of the kind willingly. The Chattanooga region gave particular reason for an unfavorable view of the dangers of fissured rock, because of the costly experience with the Hales Bar Dam twenty or thirty years ago. Yet it was necessary to accept the Chickamauga location, for reasons indicated fully in the statement on p. 665; perhaps the controlling reason was the demand for flood storage close to Chattanooga, to reduce the large annual flood damage to which the extensive flood-plain areas of that city are exposed. In future many unfavorable damsites will have to be accepted, since free choice of site is not always possible in the later stages of a river's development. It will therefore become increasingly necessary to find ways of building good dams on bad foundations, which gives added interest to the methods worked out at Chickamauga. A good foundation will always remain the most important consideration in choosing a damsite, but study of successful methods for building on unsatisfactory foundations is certain to become increasingly important.

About a Name

WHAT IS STABILIZED SOIL? Those of us who began to dip into soil mechanics in its earlier manifestations came to think of stabilized soil as a mixture of graded coarse and fine non-cohesive soil particles with an added void filler of plastic soil particles, usually clay. But now we hear that nearly any kind of soil, cohesive or non-cohesive, mixed with cement, tar, asphalt, lignin or other artificial binder, is called stabilized soil—and seemingly everyone accepts the definition. We have no objection to offer to any of these recent soil and binder mixtures as useful materials in roadbuilding, but we ask: Are they stabilized soil? Recently soil physicists have had to adopt the word "consolidation" and assign to it quite a different meaning in soil mechanics than it had had in common usage, where it was synonymous with solidification. Perhaps similar action needs to be taken with the term stabilized soil. Certainly there is little relationship between the precise arrangement of soil-particle sizes and qualities to produce immobility under load and the pasting together of any sort of earth with an artificial binder to make it firm.

Qualification Needed

LAST WEEK we published a comparison of designs for a gravity dam and an arch dam at the Ruby site, now being developed by Seattle, in which the author concluded from the statistical record that arch dams have inherently greater reserve strength. This conclusion is so far-reaching as to merit careful examination. Is the record open to such interpretation if all the attendant facts are considered? The fact was cited that 69 gravity dams have failed and that no arch dam has failed, and this was held to give a score of 69 to 0 in favor of arch dams. However, the great majority of the gravity dams that failed were built long before dambuilding reached its present stage of development, and many of them in days when the art was strictly empirical. Had the same engineering skill been applied to their design that was applied to the design of arch dams built in more recent years, and had the same thorough preparation been given to their foundations as is now universal, the record might be different. Or, to reverse the comparison, there is no ground for believing that an arch dam whose supporting rock was of the kind that brought failure to the St. Francis gravity dam would have escaped the fate of the latter. This is said in no

spirit of disparagement of arch dams, and it may well be that full consideration of practical conditions would credit them with greater inherent safety. But the gravity dam, of time-honored service, deserves a word of justification against a charge that is more properly directed against the shortcomings of engineering knowledge.

Useful Clarification

LAST WEEK'S CONVENTION of the Federation of Architects, Engineers, Chemists and Technicians at Detroit was visible evidence of a unionizing movement of substantial proportions in the engineering field. Just what the term "union" will mean in practical application to engineering work is still obscure, and so long as this obscurity remains all those who read into it the full connotation of those labor-union manifestations that have been front-page news for many months are justified in looking on it with suspicion.

Insofar as the engineering union movement represents an effort to better the economic condition of engineering employees it is entitled to a sympathetic hearing; and if its objectives are well grounded and reasonable, and its methods are orderly and compatible with trustworthy, efficient performance of engineering function, it may prove able to render an important service. The union movement could do nothing more useful to its own interests than to make clear its attitude on these points.

Such clarification is especially important because of the recent affiliation of the Federation with Lewis' C.I.O. If this joining together of shop labor with engineering employee staff means the use of identical methods and mutual support of one group by the other through sympathetic and general strikes the fact should be known, for the information of those who may undertake to enter into agreements with the F.A.E.C.T. If on the other hand the latter body despite the C.I.O. subsidy will stand on its own feet and will live up to every agreement it makes with employers, an unequivocal declaration to this effect will do much to clarify the issue.

Clarification is equally important with respect to the relations between employed engineers and sub-professional assistants under a union system, now that the F.A.E.C.T. has enlisted some licensed professional engineers in its ranks. If unionization is to be applied to the work of the former, will it be of the normal union kind or will it be subordinated to the engineer's controlling obligation to discharge the responsibilities he has assumed? If the Federation expects the planning engineer to go on strike whenever the blueprint boy has a grievance, engineering operations would become manifestly impossible. If, on the other hand, its members will consider an agreement to be individually as well as jointly binding the chance for constructive understanding and harmonious relations would be much improved.

Organization for economic protection of engineering employees is not to be opposed or condemned of itself. Nor need it be out of harmony with sound and proper engineering relations. It is the methods used to accomplish its objects that will decide whether or not it is compatible with the engineer's function in industry and in public life.

The Next Step Forward

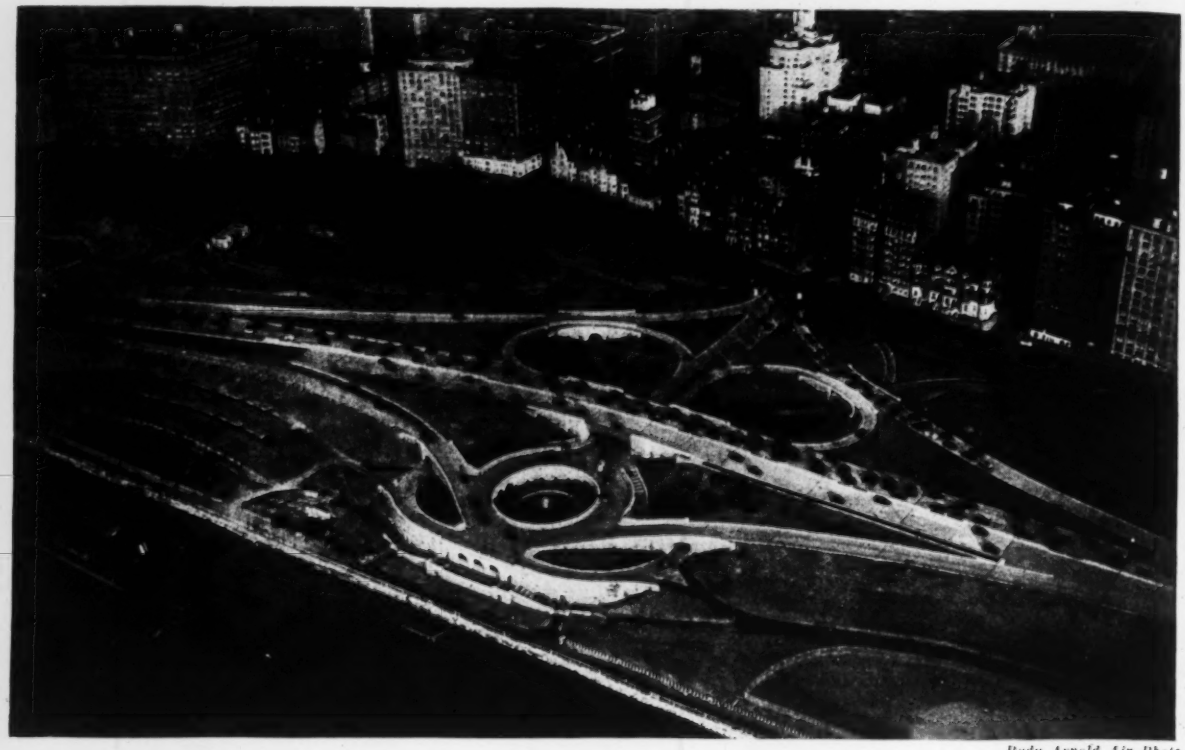
STUDY OF THE SERIES of five articles on highway lighting that we have published beginning with the Aug. 5 issue indicates a live interest by illuminating engineers in this problem. By research and field experimentation these specialists have developed principles of road lighting and an impressive array of road lighting equipment that conforms to these principles. Now the duty of carrying the banner of progress passes to the highway designer and builder.

Keeping strictly to the technical problem of producing a lighted road, what is it that the road engineer has to do? The illuminating engineer offers nothing very specific in the way of directions. Principally his studies show that surface texture and color, as well as interference from extraneous light sources, are prime subjects for consideration. Here, then, the road engineer is offered specific subjects for thought, none of which presents a simple problem. Thus, control of extraneous light is bound up with the whole subject of roadside control—restricted right-of-way, zoning of roadside building and regulation of occupational uses that give rise to interfering lighting.

Surface, texture and color present even greater difficulties. It would be idle to propose any drastic limitation of the freedom of roadbuilders to surface their roads with any material that they consider economically desirable. In final analysis the road surface is determined by traffic requirements. The road engineer must remedy the shortcomings in texture and color of whatever surface he decides to use, to adapt it to effective lighting.

To learn these defects a new field in road lighting research has to be opened up and thoroughly cultivated. The studies by C. A. B. Halvorson described in this issue are an example of the search that needs to be conducted. It calls for cooperation of the roadbuilder and the illumination expert in equal degree. Hitherto research has been confined to illumination engineers, and they have done an exceptionally good job. The time has come for the roadbuilder to take up his share of the work, in order to make the lighted road a reality.

PICTURES IN THE NEWS



Rudy Arnold Air Photo

WEST SIDE HIGHWAY OPEN OCTOBER 12. The 79th St. Rotunda of New York City's new express highway improvement on the bank of the Hudson River. The central figure of the development, this rotunda is designed on two levels. At the road level it serves as a traffic circle. Below, a pool is part of the roof of a 220-car garage. A restaurant will be built into the lower level. The new highway will reduce the overload on Riverside Drive at the right of the park.

FORT PECK GREETS NEW CHIEF. Left to right, front row: Capt. E. G. Plank, Capt. J. R. Hardin, Capt. R. Lee, Maj. C. N. Iry, Maj. Clark Kittrell, district engineer, Fort Peck, Maj. Gen. J. L. Schley, newly appointed Chief of Engineers, Gen. M. C. Tyler, assistant to the present Chief of Engineers, Col. C. L. Sturdevant, division engineer, Kansas City, Capt. C. H. Chorpening. Back row: 2d Lt. S. G. Spring, 2d Lt. C. T. Newton, 2d Lt. R. D. McCarty, 2d Lt. J. B. Rippere, 2d Lt. R. J. Harvey, 2d Lt. K. T. Klock, Jr., 1st Lt. C. Smyser.

FIG. 1. THE SECOND-STAGE COFFERDAM AT CHICKAMAUGA WILL CONTAIN THE SPILLWAY OF THE DAM

Bad Rock Limits TVA Dam Location

Chickamauga Dam on the Tennessee River is being built in an area where no satisfactory foundation rock can be found

HANDICAPPED by one of the most unsatisfactory sites on which a great masonry dam has ever been located, the Tennessee Valley Authority has made excellent progress in the construction of Chickamauga dam across the Tennessee River seven miles upstream from the city of Chattanooga. In spite of badly fissured and cavernous limestone underlying the site, with widely varying strata and constantly changing foundation, sufficient work has been done to prove that the dam may safely be completed on a site that had been determined by conditions which the engineers in charge could neither change nor avoid.

Reasons site was fixed

In the general scheme for the development of the Tennessee River for flood control, navigation, and power generation a series of relatively high dams is being constructed by the TVA from the mouth of the river to a point not far below the point where the confluence of the Holston and the French Broad forms the Tennessee. In this distance of about 650 miles nine great dams will provide a 9-ft. channel, much flood storage and a vast amount of power. Two of these are completed and three others are in various stages of construction, with work on a sixth authorized.

Chickamauga dam is the sixth above the mouth of the river in the series. Downstream some twenty miles from it is the Hales Bar dam, owned and operated by the Tennessee Electric Power Co. This private dam is not high enough to provide the established 9-ft. navigation depth from its site to Chickamauga dam. Location of the city of Chattanooga above this private dam, and the structural and foundation conditions at Hales Bar precluded raising the crest of its spillway sufficiently to create the 9-ft. depth to the site of a dam above Chattanooga. The cost of acquiring flowage area involved in raising the Hales Bar pool the required amount also was prohibitive.

Desire to provide the maximum possible flood control for Chattanooga further dictated the construction of a dam as short a distance above that city as was feasible. Preliminary drillings at the Chickamauga site by the Corps of Engineers and by the TVA, together with general statements that a dam could be built on this site, had established this location in the public mind as a satisfactory site. Subsequent intensive geological study of the site and numerous test borings by TVA early gave clear indications of unfavorable foundation conditions. Meantime, Congress had ordered that the dam be built in this general location. The site was thus rather definitely fixed by major controlling factors having nothing to do with the foundation conditions presented.

Controlling factors

While the upstream limits of the site within the general location that had been fixed by Congress were not precisely defined, they were none the less otherwise definitely controlled. Raising of Hales Bar dam and lock to provide intermediate navigation reached the point of impracticability within narrow limits. This left a dredged channel or an intermediate low navigation dam as the alternatives. Moving the proposed dam upstream from the Chickamauga site was found to increase the cost rapidly and to add to the operating disadvantages by lengthening the dredged navigation channel. Even with an intermediate low navigation dam, local conditions limited the

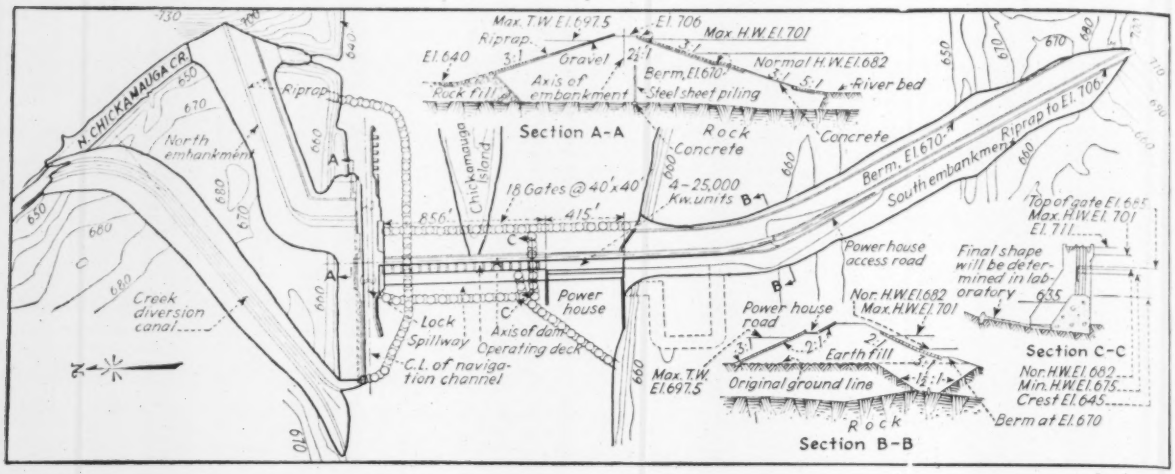


Fig. 2. **Chickamauga Dam consists of a long concrete spillway across the main channel with a power house in the channel to the right of Chickamauga Island. Long earth fills flank the channel sections.**

search for a site for the high dam to some five miles of the reach of the river directly above Chattanooga. In this area certain bad spots could be roughly determined and eliminated by superficial examination. By progressive selection and elimination the favorable sites within this reach were compared in detail as to advantage and cost. In making estimates, however, there was the uncertain item of the cost of foundation treatment as it was known that such treatment would be necessary in the limestone underlying the entire area.

Bad conditions determined

Borings disclosed large and irregular fissures, seams, caverns and solution channels in the foundation rock. The extent of these openings and their capacity for carrying water were difficult to determine. Local sink holes were occasionally formed in the overburden during the drilling operations. The discovery of an old fault in this reach, where the Knox dolomite had been upthrust to override the Chattanooga limestone, added to the complexity of the situation.

Investigation gradually narrowed down to four sites on which considerable drilling was done. Borings eventually eliminated two upstream sites. This left two possibilities: one at the downstream end of the five-mile reach, on the Chattanooga limestone just below the fault line, and one shortly upstream from the fault line on the Knox dolomite.

This upstream site at first appeared to have decided advantages. As more data from drillings became available, however, the geologists raised serious questions about the shattered rock disclosed and its uncertain condition in the formation. Drilling work on this upper site was accordingly slowed down and investigation concentrated on the lower site.

At the beginning of intensive boring of the lower site all of the cores were relatively satisfactory. As they continued, work on the upper site was stopped. On advice from the geologists, in order to avoid as much as possible the crumbled limestone immediately below the fault line, the lower site was moved downstream as far as seemed practical. This placed it immediately upstream from two creeks, North Chickamauga on that side of the river and South Chickamauga on the south side.

After this site had been practically accepted as satisfactory, drillings suddenly began to show numerous and apparently extensive cavities in the rock foundation. These cavities appeared sufficient to cause abandonment of the site to be considered and to call for re-examination of some of the other sites.

This extremity led to the decision to crowd the dam still further downstream, following the geologists prediction of sounder rock in that direction. This shift was accomplished by the rather unusual expedient of including long embankments angling upstream from the abutments on both sides. It also involved the diversion of North Chickamauga Creek.

Subsequent uncovering of the rock foundation proved the wisdom of this shift of the dam downstream. The only error in the decision was that it was not bold enough. After detailed borings proved the new site much the best, conditions of the rock foundation disclosed when part of the site was unwatered led to the shift of the whole central section of the dam still another 150 ft. farther down stream. At this final location the rock still contains so many fissures and caverns that proper preparation of the foundation has presented very difficult cleaning and grouting problems. These are being solved, however, and the result is expected to be a foundation for the dam and its embankments that is entirely watertight and stable.

Methods of exploration

In addition to diamond drilling, many 6-in. and 36-in. shot-drill holes were sunk in the flood plain to explore the foundation of the earth embankments. The 36-in. holes have been of extreme value as they permitted visual examination of the foundations and made possible a more accurate test of permeability of the rock. In addition, numerous wash borings were taken at the several dam sites and the three cofferdam locations, the latter to determine the maximum height of surface of the rock to serve as a basis for fixing the length of the steel sheet piling.

A general description of the dam as now being built is given in the following article by Lee G. Warren, project engineer. Articles in subsequent issues will describe construction methods, particularly the unusual work of foundation grouting.

Elements of Chickamauga Dam

By Lee G. Warren

Project Engineer, Tennessee Valley Authority, Chickamauga Dam, Tenn.

Concrete spillway and powerhouse sections flanked by long earth embankments

The drainage area of the Tennessee River above Chickamauga dam is 20,800 sq. mi. The mean annual flow of the river for a 61-year period is 38,400 sec.-ft.; the minimum recorded flow being about 3,100 sec.-ft. This minimum flow is expected to be increased to an average of 12,500 sec.-ft. by the release of water from Norris Reservoir; it will be further increased by other upstream regulation.

At Chattanooga the maximum stage of the river on record is 57.9 ft. which occurred March 11, 1867, the discharge at that stage being estimated as 459,000 sec.-ft. A flood of 410,000 sec.-ft. was recorded March 1, 1875.

Chickamauga dam consists of concrete structures across the main river channel, including navigation-lock, spillway and powerhouse sections, flanked by earth embankments across the valley on either side of the river. The total length is 5,800 ft., including embankments, and the average height of the spillway section in the channel from rock foundation to operating deck is 111 ft.

Both embankments are being constructed of rolled clay soils taken from adjacent borrowpits. An accompanying drawing shows the average cross-section of these embankments. The south one has a top width of 36 ft. and a maximum height above the original surface of 56 ft. The north embankment is 20 ft. wide on top and rises to a maximum height of 50 ft. The south embankment is to be 2,870 ft. long and the one on the north side, 1,410 ft.

The navigation lock, on the north side of the river channel, has a chamber 60 x 360 ft. and a lift of 51 ft. It is so located that the land wall is in line with the north pier of the navigation span of the Southern R. R. bridge which is a short distance downstream from the structure. Plans for the lock were prepared by the Corps of Engineers under a cooperative agreement with the Tennessee Valley Authority. Provision for the construction of a larger lock has been made in the spillway adjacent to the one now under construction.

Crossing the natural channel of the river and extending from the lock on the north side to a powerhouse structure on the south side is a concrete gravity-type spillway, 960 ft. long. Its deck has an average height above the rock of 111 ft., the maximum height being about 120 ft. Eighteen gates 40 x 40 ft. between piers 8 ft. thick are to control the flow of the stream. The spillway is designed to pass a flood flow of 600,000 sec.-ft., the maximum of record being the 459,000 sec.-ft. which was made in 1867.

The powerhouse section, located adjacent to the left bank, will be of concrete construction. It is to be 415 ft. long and 148 ft. wide. The present program contemplates the installation of 50,000 kw. in two units, with provision for future installations of an additional 50,000 kw.

The present channel of North Chickamauga Creek is crossed by the

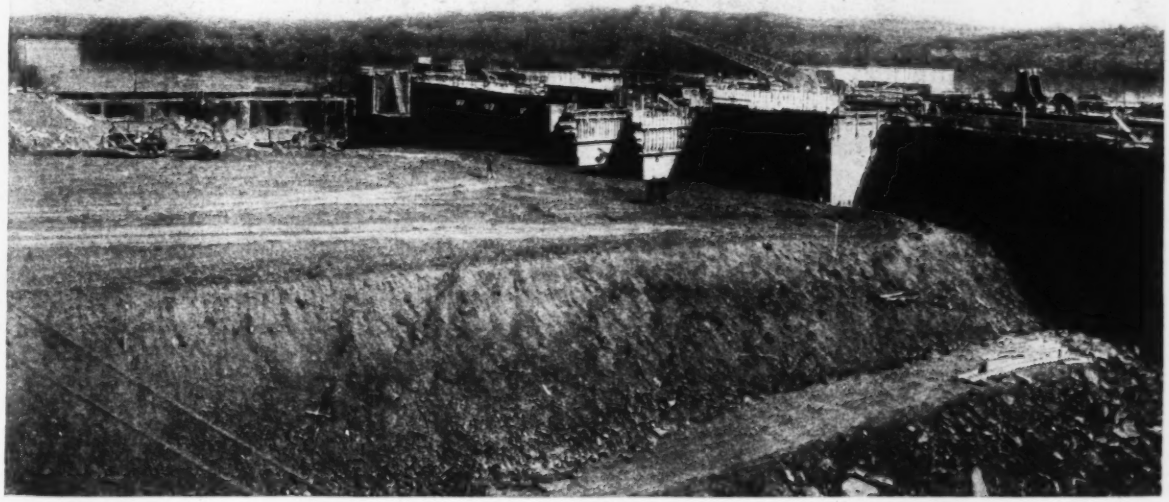


Fig. 3. The fills are of selected clay material built to the sections shown in Fig. 2.

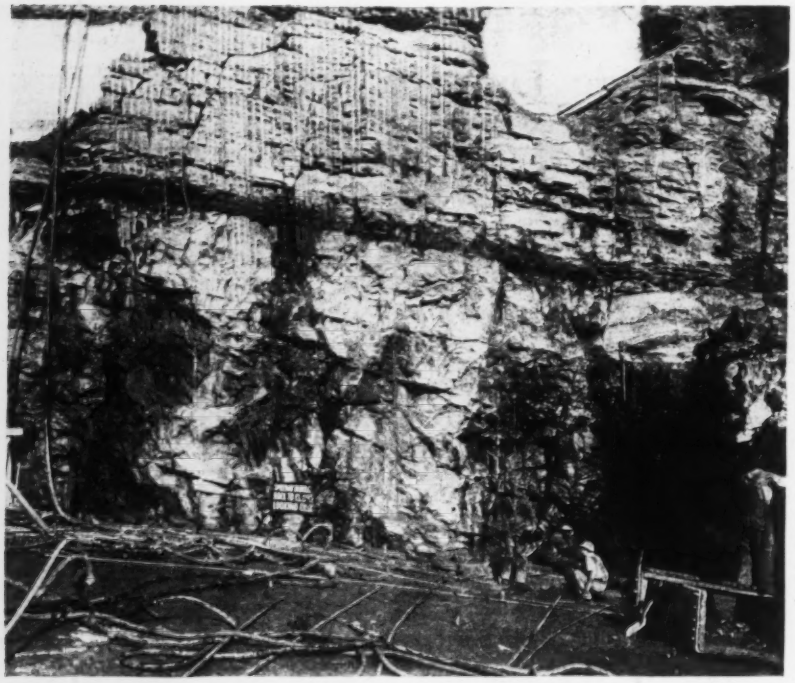


Fig. 4. Typical rock conditions revealed by the foundation excavation work at Chickamauga dam.

north embankment, hence it is necessary to divert the creek to a new outlet about 800 ft. below the dam. This diversion channel, 2,000 ft. long, will be constructed with a bottom width of 40 ft. and side slopes of 2 to 1.

The pool created by Chickamauga dam will extend upstream some 59 miles. At normal headwater elevation, it will have an area of 32,000 acres, a capacity of 541,000 acre-ft., and a shore line of 502 miles. The average width is about 0.9 mile. In the 7 ft. below normal pool is a volume of 193,000 acre-ft., which is available for re-regulation of storage releases from Norris and other upstream reservoirs or for supplementing down-river flow during extremely dry years.

Creation of the reservoir introduces problems in adjustment and relocation of highways and of a few small towns on the borders of the reservoir. The water levels in the reservoir were worked out so these adjustments would not be unduly costly.

Preparation of the reservoir for flooding necessitates the clearing of about 7,200 acres of timber from the lands in the reservoir area and from the river banks.

The Chickamauga project will extend navigation up the Tennessee River and the principal tributary in this reach, the Hiwassee River. At the present time, navigation on these reaches of rivers is practically impossible during low water stage and is difficult and dangerous at any stage, due to the numerous obstructions. The present controlling low-water depth is only about a foot at several places.

Below Chickamauga dam the dam at Hales Bar provides in excess of 9 ft. of navigable depth nearly up to Chattanooga, but only 6 ft. in the Chattanooga harbor. It is proposed to obtain the 9 ft. for the entire distance by dredging.

Location of this dam just above Chattanooga, which is the point of greatest probable flood damage in the Tennessee Valley, makes the Chickamauga project important in flood control, particularly as a unit in a complete plan which would include sufficient upstream storage to control most floods.

The existence of towns and villages around the reservoir limits the maximum feasible height of the reservoir surface and the storage capacity available in the reservoir. It is impracticable to construct the dam high enough to provide very substantial storage during floods such as the maximum of record. The dam will have a limited effect, however, in controlling such extreme floods and will be of material value in controlling moderate floods.

If the level of the water in the reservoir is drawn down to the minimum required by navigation in anticipation of a flood, a volume of 325,000 acre-ft. is available for flood storage up to the top of the spillway gates. It is calculated that an extreme flood may bring the water level 16 ft. above the top of the gates, in which case an additional volume of 820,000 acre-ft. would be temporarily held in the reservoir.

Chickamauga, like other projects on the Tennessee River, is a run-of-river plant with partial regulation of the stream flow by upstream storage reservoirs. The prime power of the project as an individual plant would be limited during dry periods to the amount that could be produced from the available flow; during flood periods it will be determined by the available capacity and head. In extreme floods the head will be reduced to a negligible amount. However, as part of an integrated system of power plants on the main river and tributaries the plant at Chickamauga will add 50,000 kw. of primary energy.

Construction stages

Construction of the project is to be done in three stages covering an estimated period of five years. The lock was first completed in a cofferdam on the north side of the channel. The next stage is the construction of the spillway now under way in a cofferdam 314 x 728 ft. across most of the channel of the river. As soon as the spillway is finished, the power house will be built in a third cofferdam along the south bank.

The Chickamauga project is being carried out under the general direction of Arthur E. Morgan, chairman and chief engineer of the TVA. Carl A. Bock is assistant chief engineer and Theodore B. Parker is chief construction engineer.

For the Chickamauga project, the author is project engineer, James B. Hays is construction engineer; Joe K. Black, assistant construction engineer; F. C. Wardell, office engineer; Fred C. Schlemmer, construction superintendent; G. E. Murphy and James S. Lewis, assistant construction superintendents.

Radio Towers for Illinois Police

by A. BENESCH
Engineer of Grade Separations, Illinois Division of Highways, Springfield, Ill.

Seven self-supporting antenna towers spotted throughout the state furnished an interesting structural problem for engineers of highway department

THE RADIO SYSTEM of the Illinois State Police, consisting of seven strategically located broadcasting stations each complete with its own 1,000-watt transmitter and antenna system, is conceded to be one of the best planned and most efficient of the police radio systems in the country. The design of the towers or radiators for this system was assigned to the bridge department of the Illinois division of highways and furnished an interesting and unusual problem.

The design work began after a firm of radio consultants had made a survey to determine the number and location of stations (Fig. 2) necessary to produce a minimum signal strength of 100 microvolts in all parts of the state. Although six stations would have accomplished the desired result, a seventh was added at Springfield, the capital city and headquarters of the Illinois state police.

Electrical considerations, taking into account best-balanced day and night coverage with minimum fading of signal, dictated the use of uniform cross section vertical radiators of 190 deg. physical height. At the operating frequency assigned by the Federal Communications Commission, the final height was fixed at 330 ft. above base insulators. Since it was felt that the use of guys would introduce unnecessary hazard and increase maintenance costs, self-supporting towers with maximum face width of 20 ft. were specified. To reduce the number of parts and to obviate the necessity for internal sway bracing, the state's structural design was based on a triangular rather than a square cross section. The tops of the base insulators were placed 8 ft. above ground to secure protection from snowdrifts and to protect the unwary against high-frequency skin burns. At the top and third points of the radiators, steel grating walkways were provided to facilitate maintenance of the ob-

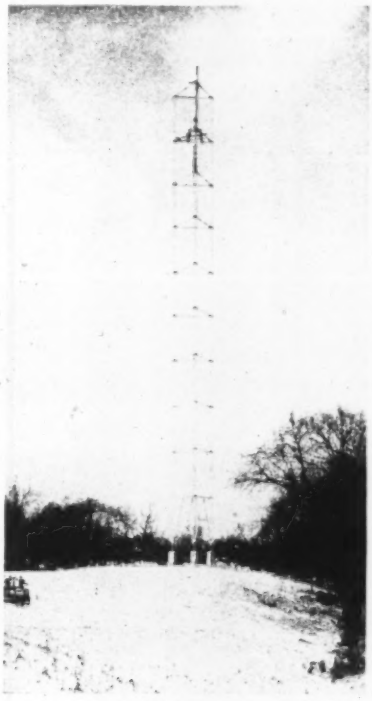


Fig. 1. Gin-pole erection of one of the 330-ft. radiators for the Illinois police radio system.

struction lighting system required by the Bureau of Air Commerce.

These were the basic requirements. The actual design of the structures was made on an unusually conservative basis to eliminate any possibility of interruption of service. Maximum deflection at the top at 90 mile indicated wind velocity was, for example, limited to 13 in. The allowable unit stresses were specified as follows:

Axial tension on net section, 18,000 lb. per sq.in.; axial compression on net section $\frac{20{,}000}{1 + \frac{L^2}{20{,}000\,r^2}}$ with a maximum of 16,000 lb. per sq. in. and without additional allowance for stresses due to wind or any other combination.

Shop work was required to comply with the state's bridge specifications and all welding with the specifications of the American Association of State Highway Officials. Shop connections were to be riveted or arc welded. Ratio of slenderness of compression members was limited to 120 for main legs and to 160 for web members. Minimum thickness of all members except filler plates was fixed at 5/16 inch.

Further design requirements were that a wind pressure of 30 lb. per sq.ft. on flat surfaces or 20 lb. on cylindrical surfaces should be applied to the normal projected area of one face of the tower, or an equal load applied either parallel to any face or bisecting the angle between any two adjacent faces. Foundations were designed to resist 100 per cent overload without exceeding a maximum allowable soil pressure of 4,000 lb. per sq.ft. The base insulators, consisting of porcelain cones set in steel frames, were required to resist an overload of 200 per cent. The porcelain is of a quality comparable to that in the finest China.

On the basis of these specifications the bridge department prepared a design which consisted of a conventional K-type frame, 20 ft. wide on each of its three faces. All members were angle sections, the leg members varying from 8x8x1-1/16-in. single angles per leg at the bottom, to 4x4x 5/16 in. single angles at the top. All diagonals and horizontal bracing

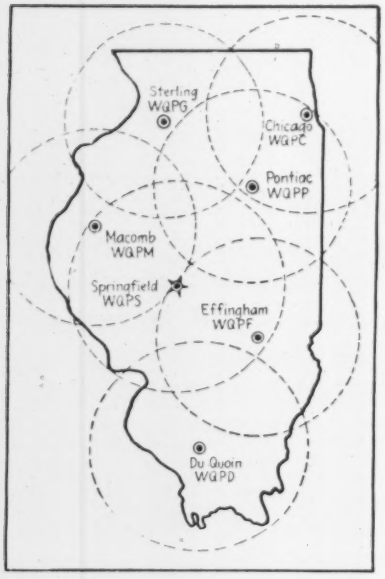


Fig. 2. Seven radio stations have broadcast areas that completely blanket the state.

members consisted of two 3x2½x5/16-in. angles.

The design finally chosen as most closely approaching the spirit and letter of the specifications was submitted by the Truscon Steel Co. The construction consists of Warren rod trussing in the three faces of each leg, largely of solid rounds arc welded in the shop into unit length columns connected in the field by means of horizontal angle struts and diagonal rod bracing. All field connections were made by means of maul-driven rivet-bolts.

The advantage of using round sections instead of flats was conclusively demonstrated in wind tests made by the Guggenheim Air Institute. Since the major forces on a tower of this type are wind forces, utilization of members which have a minimum resistance is desirable. Also, a considerable saving is effected in weight of metal by using round sections, which is only partly offset by the increase in shop fabrication. Furthermore, a greater and uncontested saving can be made in the foundations and in the insulators. Whereas the insulators used cost only $400 each, the price of insulators for the K-bracing design with angle sections would have been $660 each.

Butt or flange joints at all connection points subject to stress reversal reduce deflection to a minimum. Excepting for the shop-riveted panel immediately above the base insulators, no web member suffers stress reversal. Incorporation of solid round members results in heavy average material thickness, and it is not expected that maintenance will be a serious problem.

The erection method used is indicated in Fig. 1. As each panel or bent was completed the gin pole was raised an equivalent amount to handle the next completed panel. Hoisting power was furnished either by horses or by a tractor.

In order to guarantee a truly vertical tower, no erection was permitted above the 100-ft. level at wind velocities exceeding 15 miles per hour. To protect tower and insulators against lightning, the tower was ground-wired during erection. Permanent protection against lightning was provided by means of horngaps

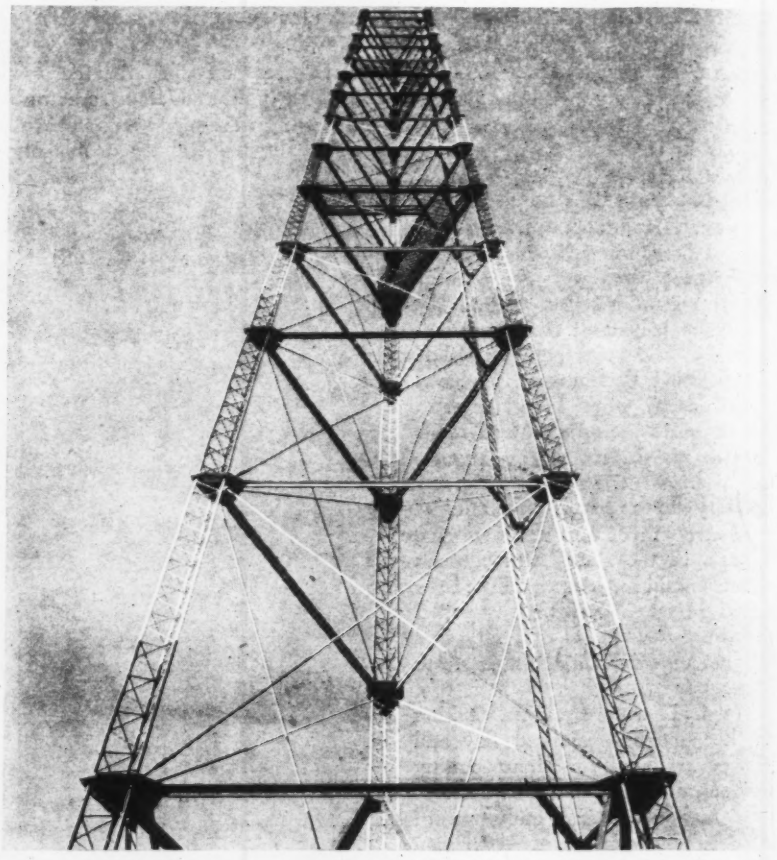


Fig. 3. The radio tower legs consist of welded triangular members assembled from round rods. Wind forces on the round sections are less than on flat surfaces, and a considerable saving in metal and foundation costs also resulted from their use.

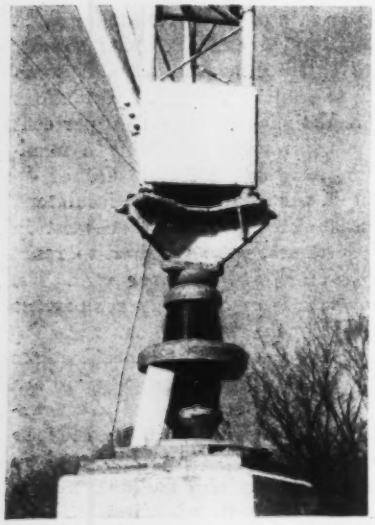


Fig. 4. Porcelain insulators under the tower legs transmit all loads to the foundations.

which were placed on top of the insulators and bonded to the radial-wire ground system.

In addition to a shop coat of priming paint, three field coats were applied, the last two of which consisted of alternate bands of international orange and white to comply with obstruction requirements of the Bureau of Air Commerce.

The plans for the radio towers were approved by Ernst Lieberman, chief highway engineer. Glenn E. West is radio engineer for the state, and the writer was in charge of the design of the towers and supervised their construction. The transmitter buildings at the various stations were designed by Ralph Harris, architect of the state highway division, each building being treated to blend with its surroundings. Truscon Steel Co., Youngstown, Ohio, was the contractor for towers and ground system.

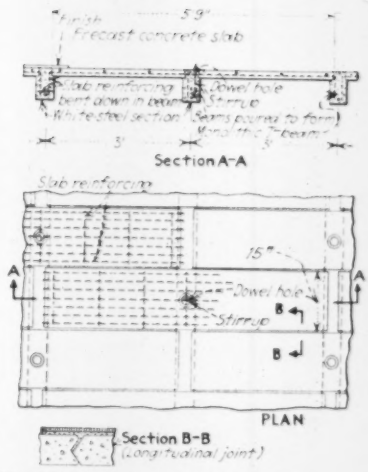


Fig. 1. Details of slab and beam construction and assembly.

Precast Reinforced Concrete Slabs For Floors and Roofs

by H. T. HEALD

Dean, Armour Institute of Technology, Chicago, Ill.

Investigation of slab structural action being carried out by Armour Institute of Technology

COMPLETE INVESTIGATION of the structural action involved in a patented system of precast, lightweight concrete slabs supported by poured-in-place concrete beams, devised by Eugene A. White, of Chicago, is being conducted by the Research Foundation of Armour Institute of Technology, Chicago. The general features of the construction are illustrated in Fig. 1. The precast slabs, 5 ft. 9 in. long, and 13 in. wide, are designed to act as a unit with poured-in-place concrete beams. Forms for the beams are provided by specially designed pressed-steel sections which have sufficient rigidity to support the slabs during construction operations. Slabs and beams are securely joined by extending the mesh reinforcing from the ends of the slab into the beams where it also serves as stirrups. Additional connection is obtained by the use of dowel holes in the center of the slabs into which stirrups are inserted. The slabs are prefabricated to exact specifications, in steel forms, using lightweight aggregate, and accurate control of slab dimensions makes possible a tight-fitting longitudinal joint between the slabs as illustrated by the detail in Fig. 1.

This construction may also serve for roofs, with the steel beam section acting as purlins to which the precast slabs are attached. When used on roof construction the longitudinal joints between the slabs are filled with plastic cement. The 2-in. standard slab used for floor construction has a weight of 17 lb. per sq.ft., while the roof slab weighs 13 lb. per sq.ft.

Fig. 2 shows the steel beam forms in place on the floor of a new park recreation building, built with WPA funds at Glen Ellyn, Ill., and Fig. 3

Fig. 2. Steel beam forms in place. Note slabs in upper right.

Fig. 3. After the precast slabs are laid on the forms, the beams are poured

shows the beams being poured after floor slabs, made by the Massey Concrete Products Corp., have been placed. Ordinary aggregate was used for the concrete in the beams in order to provide greater ease in placing. Using a relatively wet mix, no difficulty was experienced in securing proper filling underneath the slabs and up through the dowel holes.

The designer of the system assumes that the slab and supporting beams act as a monolithic structure, and may be designed in accordance with the ordinary T-beam principles. Preliminary tests made at Armour Institute on floor panels and on a 10 x 10-ft. test panel seem to indicate that the slabs and beams may be considered to act as a unit.

Kentucky Builds Record Bridge

by E. D. SMITH

Assistant Bridge Engineer, Kentucky State Highway Department, Frankfort, Ky.

Longest continuous steel deck girders in the country, 474 ft. in three spans, will be used at Frankfort

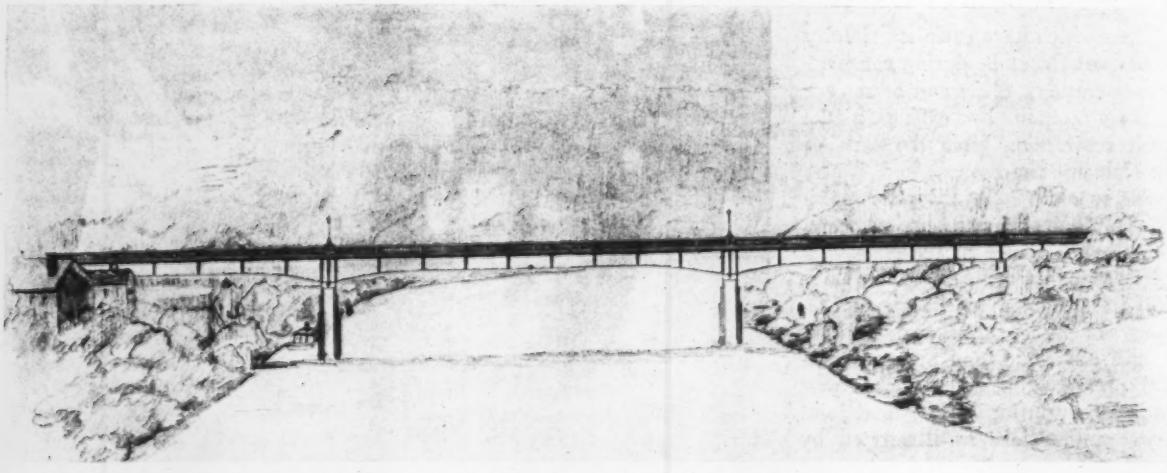
THE RIVER CROSSING of the Capital Memorial Bridge, now under construction over the Kentucky River in Frankfort Ky., consists of a three-span continuous steel deck-girder unit 474 ft. long, believed to be the longest in this country. A pleasing appearance being a major design consideration, since the bridge will cross the river in direct line with Capitol Ave., a deck-type bridge was chosen so as to leave the view of the State Capitol unobstructed. The main span of the continuous unit is 200 ft. and the flanking spans 137 ft. Comparative estimates, using a 300-ft. steel tied-arch, a 300-ft. steel Warren truss, and a 300-ft. half-through concrete arch, indicated that the bridge as designed will be as economical as any of the other types considered. The foundations for the continuous spans are carried to rock while piles are used beneath the piers of the three 67-ft. steel girder spans that compose the south approach. Foundation construction is now under way.

Design features

A minimum vertical navigation clearance of 45 ft. was required for the main span which necessitated girders of shallow depth. The 200-ft. main span proved to be about the longest that could be used and still maintain the shallow depth and comply with the deflection requirements of the Bureau of Public Roads. The structure was designed for an H-20 live load, and an impact factor of 18 per cent was used on the continuous deck plate girder. Copper-bearing structural steel will be used throughout. Moments, shears and reactions were computed for the continuous unit by the Hardy Cross method of distributing fixed end moments, (*Transactions*, Am. Soc. C. E., Vol. 96). The beam constants were determined as outlined in the discussion of Professor Cross' paper by Prof. George E. Large. A dead-load plus one-half live load deflection curve was made for the continuous unit, using M/EI as a loading, and camber will be placed in the girders corresponding to this calculated deflection by adjusting the outline of the web plates to compensate for the deflection.

Five girders in span

There will be five longitudinal girders in the continuous unit spaced 7½ ft. on centers, with cross-frames at 12 ft. intervals and lateral bracing attached to the bottom flange of the girders. The concrete roadway slab, resting directly on the top flanges of the girders, will provide top lateral stiffness. Web plates will be ½ in. thick for the interior girders and 9/16 in. thick for the exterior girders, and will vary in depth from 150 in. over the main piers to 84 in. at the center of the main span. Flange angles will be 8x8x¾ in.; two ¾-in. cover plates will be used on the interior girders while the exterior gird-



Architectural rendering made by the author of the 474-ft. continuous girder unit in the Capital Memorial Bridge at Frankfort, Ky.

ers will have two 18x$\frac{3}{4}$ in. plates and two 18x$\frac{1}{2}$in. plates. All girder stiffener angles will be either milled to bear or fit tight with the girder flange angles.

The reinforced concrete deck will provide for a 30 ft. clear roadway and there will be two 6-ft. cantilevered sidewalks. The 8-in. slab with the main reinforcement transverse to the direction of the traffic will be reinforced with $\frac{5}{8}$ in. round deformed bars on 5-in. centers, top and bottom. Transverse expansion joints at about 35 ft. intervals will be made with 24-oz. soft sheet copper and premolded joint filler. A $\frac{3}{4}$-in. integral concrete wearing surface will be used since a finish of this type has proved satisfactory on other state bridges. Reinforced concrete hand rails and special lighting fixtures have been designed to enhance the appearance of the bridge.

Administration

The plans were prepared by the bridge department of the Kentucky department of highways. Robert Humphreys is commissioner of highways, Thomas H. Cutler, chief engineer, G. L. Logan, director of construction, H. R. Creal, bridge engineer, W. W. Pardon, district engineer, and H. E. Rudy, resident engineer. The substructure is being built by the Sandy Hites Co., Kansas City, Mo. ($174,000). The steel superstructure is being fabricated by the Bethlehem Steel Co. ($158,000). The square foot roadway cost of the bridge will be about $12.

• • •

Lincoln Tunnel Work Ahead of Schedule

CONSTRUCTION of the Lincoln Tunnel connecting Manhattan Island with Weehawken, N. J., under the Hudson River will have progressed so far by Oct. 15, that it will be possible to run an automobile all the way through the south tube, which is now nearing completion.

On that day the governors of New York and New Jersey have been invited to go through the tube. Simple ceremonies will follow. Construction of the first operating unit is several months ahead of the original expectations, and assures the opening for public use by New Year's Day.

Beam Deflections Without Integrating

by K. HAJNAL-KONYI
Consulting Engineer, London, England

Mohr's theorem is applied directly to beams with any support conditions to determine beam deflections

THE DEFLECTIONS of a simply supported beam were determined by applying Mohr's theorem and considering the beam as two cantilevers in the article "Determining Beam Deflections Without Integrating" by Odd Albert, *ENR*, Dec. 10, 1936, p. 828. This simplifies the direct method based on the differential equation of the elastic line by replacing complicated integrations by Mohr's theorem. The substitution of the two cantilevers for the simply supported beams is not necessary, however, for Mohr's theorem can be applied directly not only in the case of the simply supported beam but to beams with any other support conditions as well.

Mohr's theorem is applied directly to a simply supported beam subjected to any loading by treating the bending moment diagram divided by EI as a load, from which load a second bending moment diagram is obtained which is the elastic line of the beam. The ordinate of the shear diagram of the M/EI load at a point gives the slope of the elastic line at that point, and thus, the reactions of the M/EI load are the tangents to the elastic line of the beam at its supports. The following three examples in which both E, the modulus of elasticity, and I, the moment of inertia of the section, are assumed constant to permit the use of the original bending moment diagram, illustrate this direct application of Mohr's theorem.

Bending moment load example

For a simple beam (Fig. 1a) loaded by a bending moment, M, at the right-hand support, Fig. 1b shows the original bending moment diagram which when divided by EI is the M/EI load, Fig. 1c the shear

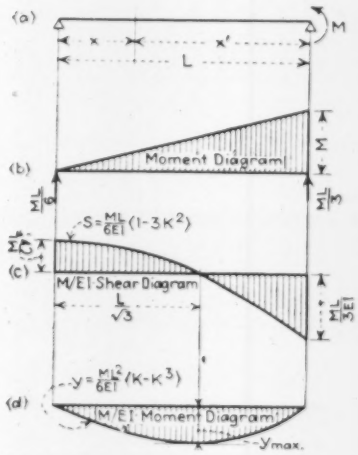


Fig. 1. **Deflection of simply-supported beam due to a moment load at one support.**

diagram of the M/EI load and Fig. 1d the moment diagram of the M/EI load which is also the deflection curve of the beam. Denoting $\frac{x}{L}$ as k:

The slope of the elastic line is:

$$S = \frac{ML}{6EI}(1-3k^2) \qquad (1)$$

The beam deflection is:

$$y = \frac{ML^2}{6EI}(k-k^3) \qquad (2)$$

The parenthetical portions of the above two formulas are denoted in German literature as

$\tau_A = (1-3k^2)$ and $\omega = (k-k^3)$

For a moment load at the left-hand support the same functions in terms of k′ (x measured from right support) are obtained and are denoted as τ_B' and ω_B' The reactions R_L and R_R of the original bending moment load (EI multiplied by the slope of the elastic line at supports) are fundamental values in the calculation of highly indeterminate systems. In

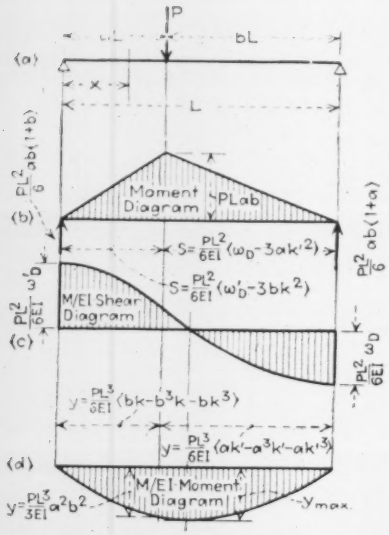


Fig. 2. Deflection of simply-supported beam due to a concentrated load.

practical calculations it is helpful to multiply equations (1) and (2) by $\frac{6}{L}$ and to introduce $\frac{6}{L}$ multiplied by the reaction of the original bending moment load. These values $\frac{6R_L}{L}$ and $\frac{6R_R}{L}$ are called "loading terms" and many German books contain tabulated values of these "loading terms" for different types of loading. These terms are also used in the graphical methods of resolving statically indeterminate systems.

The ω_D and ω'_D values are the elements of influence lines of statically indeterminate systems, giving the elastic line of a simply supported beam loaded over one support by a bending moment.

Concentrated load example

For a simply supported beam with a concentrated load (Fig. 2a) at any point on the span, the "loading terms" $\frac{6R_L}{L}$ and $\frac{6R_R}{L}$ are:

$L_L = PL\omega'_D$ and $L_R = PL\omega_D$

This is a consequence of Maxwell's theorem of the reciprocity of elastic deformations; namely, that the deflection line due to a unit bending moment at a support is at the same time the influence line of the slope at that support in the loading system.

The shear diagram consists of two parabolas having a common tangent at the point of application of the load.

The equation of the slope of the beam is not necessary for calculating deflections as they can be obtained directly from the moment diagram of the $\frac{M}{EI}$ load (Fig. 2d). The deflection equations are as follows:

$$y = \frac{PL^3}{6EI}(bk - b^3k - bk^3) \text{ when } k < a$$

$$y = \frac{PL^3}{6EI}(ak' - a^3k' - ak'^3) \text{ when } k' \leq b$$

The maximum deflection occurs at

$$x' = L\sqrt{\frac{1-a^2}{3}} \text{ when } a < \tfrac{1}{2}$$

$$x = L\sqrt{\frac{1-b^2}{3}} \text{ when } b \leq \tfrac{1}{2}$$

and always occurs in a region between x = 0.422 L and 0.578 L. When the concentrated load is at the center ($a = b = \frac{1}{2}$) the maximum deflection is equal to $\frac{PL^3}{48EI}$. The beam deflection curve (Fig. 2d) due to a unit load P at a point is also the influence line of the deflection at that point. For a group of concentrated loads $P_1, P_2, P_3 \ldots P_n$ applied at points $A_1, A_2, A_3 \ldots A_n$ respectively and with the ordinates of Fig. 2d at the points denoted as $n_1, n_2, n_3 \ldots n_n$, the total deflection due to the group of concentrated loads is

$$y = \sum_{i=1}^{i=n} P_i n_i$$

For a fixed-end beam subjected to a concentrated load at any point (Fig. 3a) the effects of the end moments are added to the equations of the preceding examples. The values of these moments, $M_L = -PLab^2$ and $M_R = -PLa^2b$, are substituted in the deflection equations of the bending moment load example and added to the deflection equations of the simple beam with concentrated load example. The resulting equations are:

$$y = \frac{PL^3}{6EI}(bk - bk^3 - b^3k - cb^2\omega'_D - a^2b\omega_D) \text{ when } k < a$$

$$y = \frac{PL^3}{6EI}(ak' - ak'^3 - a^3k' - ab^2\omega'_D - a^2\omega_D b) \text{ when } k' < b$$

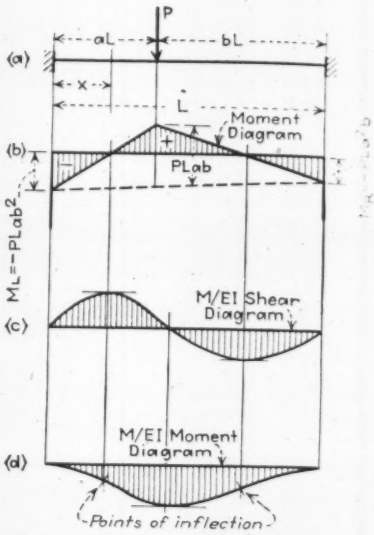


Fig. 3. Deflection of fixed-end beam due to a concentrated load.

When the concentrated load is at the center ($a = b = \frac{1}{2}$) the maximum deflection is equal to

$$\frac{PL^3}{192EI}$$

The limited extent of this discussion makes it impossible to give further particulars but the above examples show how the deflection may be determined in every practical case without integrating.

• • •

Bank Building Requirement Made Stricter

STRICTER minimum requirements for 6-story apartment houses in the boroughs of Brooklyn and Queens, New York City, have been put into effect by the Group V Mortgage Information Bureau which is composed of savings banks in those boroughs. The revised specifications became effective Oct. 1.

Outstanding among the new requirements is the provision that architectural supervision be furnished on all buildings and that each new building shall have a building superintendent on the job during the entire period of construction. The use of second hand brick is prohibited entirely; this step was taken not because of the quality of second hand brick but because of its frequent misuse by builders who do not take care that it is properly cleaned and properly laid. The use of second hand steel is also prohibited.

Public Works Parley At Atlanta

American Public Works Association devotes a three-day conference to personnel, planning and operating problems in municipal administration

ATLANTA, hub city of the Southeast, was host to the 200 delegates attending the 43rd annual convention of the American Public Works Association on Oct. 4-6. Highlighted in the sessions devoted to varied problems in municipal work were discussions on street pavement construction, rate charges for city-owned utilities, and improvement of public service personnel. Special attention was focused on Atlanta's sewage disposal program and the Birmingham industrial water supply system now nearing completion.

Published in last week's issue of *ENR*, p. 621, is the list of officers elected and the recipients of honorary awards.

Governor Rivers of Georgia, addressing the convention, urged that public money be spent for public works instead of relief. He pointed out that an active state planning board was coordinating natural-resource development and public-works programming in order that Georgia would be properly prepared to cope with the new industrial expansion in the South.

For better personnel

Questions concerning the betterment of public works personnel were the subject of a round table discussion led by Stuart Weaver, executive assistant to the director of public works, Montclair, N. J. Members of the panel taking part in this discussion were: R. D. Severy, Public Administration Service, Chicago; Chas. S. Shaughnessy, chief examiner, Philadelphia Civil Service Commission; F. T. Paul, city engineer, Minneapolis; and E. R. Knebes, assistant city engineer, Milwaukee.

It was generally agreed that further development and wider application of the merit system in public service personnel administration would attract and hold desirable men in governmental work. This means that present ideas and operation of so-called "civil service" methods must be overhauled to eliminate long recognized weaknesses.

The objectives of a merit system provide for: competitive entrance examinations; an orderly program of promotion and salary increases; standards of equal pay for equal types of work; in-service training, intensification of the career service concept; and removal of incompetents.

Summarizing the panel discussion E. J. Cleary, assistant editor, *Engineering News-Record*, forecast that one of the major problems which will soon require attention is labor union organization in the ranks of municipal personnel. City-employed engineers and draftsmen in Chicago, it was said, have been organized under A.F. of L. auspices. When and if this movement extends to other cities personnel problems will become even more complex than those existing today.

The importance of the personnel problem was recognized in the following resolution which was unanimously approved:

Resolved that the American Public Works Association strongly endorses the adoption of the merit system of personnel administration in government service including the selection, promotion and retirement of administrative employees on the basis of merit and hereby authorizes the Board of Directors to cooperate with the governing bodies of other organizations in securing this objective.

Research in street paving

Practices in street paving on which there is a vital need for more precise information was the subject of a symposium covering three types of paving-brick, concrete and bituminous.

Roy L. Phillips, city engineer, Meadville, Pa., opened the discussion on brick pavement by stating that base courses under brick surfaces have been controversial for years. Concrete is generally accepted as the best type of base but the question of rich versus lean mix has not been settled. Some cities use as little as 5 in. of lean concrete (1:3:6) while others use as much as 8 to 10 in. of rich concrete (1:2:4). The answer to which is best, he said, undoubtedly will be found if research be carried on in connection with sub-grade, load distribution and cushion material.

The cushion problem was said to be rivalled only by the question of fillers for first place in brick paving. Thus far the bituminous mastic bed gives the greatest promise of meeting the requirements for a cheaply mixed and applied cushion which will retain its shape and position. However, the best specifications today defining the characteristics of the materials in this mastic bed and their proportioning and mixing allow too much latitude.

Concrete pavements

Probably the most desirable field for research on concrete is that in which the properties of the subgrade are considered in their relation to the pavement slab from the standpoint of "balanced" design, according to a paper by H. F. Clemmer and Paul W. Downey, engineer of materials and assistant engineer, respectively, department of highways, Washington, D. C.

Stresses other than those caused by super loads constitute a most vital durability factor; for example, internal stresses resulting from curling action or volume changes can greatly exceed those resulting from the effects of legal wheel load applications. It was stated that research might be instituted in connection with factors affecting the reduction of such stresses in order to increase the serviceability of pavement slabs.

Studies pertaining to the efficiency

of expansion joints and devices for load transfer offer possibilities for improved concrete road design.

Bituminous pavements

Although bituminous materials have often been blamed for road failures when the fault was elsewhere, the fact remains that there are many problems definitely connected with the character and behavior of the bituminous material that must be solved, said J. T. Pauls, senior highway engineer, U. S. Bureau of Public Works, Washington, D. C.

A satisfactory laboratory method for quickly pre-determining the weathering qualities of a bituminous material was held to be an important need.

Recent studies have shown that asphalt may be seriously damaged in hot-plant mixing operations. Under certain conditions time and temperature practices should be revised to prevent hardening. Further work along this line and modification of plant design will greatly improve the behavior of hot-mix pavements.

Stripping of bituminous material from aggregate under the action of moisture is now receiving considerable attention as a possible cause of failure with certain types of aggregate and with some types and grades of bituminous materials, said Mr. Pauls. It seems desirable, therefore, that aggregates and bituminous materials be tested for their resistance to stripping as a prerequisite for use in construction.

Sewage disposal in Atlanta

Sewer extensions and the construction of five treatment plants, costing about $7,000,000, are now being completed in Atlanta. This program, representing one of the major sanitation activities in the South, was described by M. T. Singleton, consulting engineer and W. A. Hansell, assistant chief of construction of the city of Atlanta.

Sewage treatment was first introduced in Atlanta during the period 1910-14 when three Imhoff tank and sprinkling filter plants were built. Since that time the city almost doubled in size but enlargement of facilities did not keep pace with growth. Consequently much sewage was discharged untreated into the small streams which have their headwaters in the vicinity of Atlanta and pollution nuisances were acute.

In 1930 an improvement plan was made but work was not started until 1934, when federal funds became available. The plan provided for the abandonment of two of the original treatment plants, reconstruction of the Intrenchment Creek plant, and the construction of four new plants. Also included was the installation of about 78 mi. of sewers ranging in size from 8 to 9 in. in diameter.

The 40 m.g.d. Clayton plant, employing sedimentation and seasonal chemical treatment, sludge digestion and mechanical dewatering and sludge gas power production, is the largest of the group. Remodeling work on the Intrenchment Creek unit (14 m.g.d.) consisted of the conversion of Imhoff tanks into straight line clarifiers, enlargement of trickling filters, and the addition of a magnetite filter for final clarification. Sludge gas derived from the digestion process will be used for power generation.

A novel feature of the treatment at Intrenchment Creek will be the introduction of carbon dioxide gas into the sewage for controlling the excessively high pH caused by the presence of caustic wastes from textile industries. The CO_2 gas will be recovered from the sludge gas or the stack gases developed by the engine and hot water heater operations.

The South River plant, recently completed, is a 6 m.g.d. trickling filter and separate sludge digestion unit. At the Utoy plant (3 m.g.d. capacity) sedimentation, sludge digestion and drying beds will be employed.

Incineration at Atlanta

Incineration of refuse has been highly successful at Atlanta since the first plant—a 50 ton unit—was built in 1894, according to H. J. Cates, chief of the sanitary department, who traced the development of incinerator facilities in that city. The initial installation was followed by a 150-ton unit constructed in 1904, and in 1912 a 250-ton plant was placed in operation.

The latter plant was designed to utilize waste heat for steam generation which operated two turbine-driven generators of 35 kw. each. In 1924 the city incinerator contracted to supply surplus steam to a private gas works at 16c. per thousand pounds, with a minimum use of 260,000 lb. per 24 hr. An idea of the amount of steam generated is revealed by the figures for 1926 when 99,000,000 lb. were produced; in this same period 143,000,000 lb. of refuse were consumed.

To accommodate an increased load the plant was enlarged in 1927 to include a 100-ton unit. The furnace has 4 cells with a grate area of 26 sq. ft. each, and the boiler is rated at 12,000 lb. per hr. at 200 lb. pressure, 100 deg. superheat. With the new unit in operation excess steam was available and this was sold to the local power company. From 1925 to date the sale of steam has netted a total of $255,870.

Recent studies directed toward improving the efficiency of plant operation have revealed that the removal of No. 1 screenings (material passing a ½-in. screen, largely fine ashes and dirt) would increase the capacity of the plant, because this material has little or no heating value. Based on this information an experimental plant with vibrating screen, magnetic separator and shredder is now being operated.

Refuse collection problems

The lack of information in refuse collection practice was developed in a panel discussion led by Wm. B. Shafer, superintendent of highways and sewers, Pittsburgh. Members of the panel, representing both large and small communities, were: David Godat, maintenance engineer, New Orleans; W. E. Rosengarten, engineer, Lower Merion Township, Pa.; Lee S. Garrett, superintendent of garbage and waste, Columbus, Ohio; and John S. Flockhart, assistant engineer, Newark, N. J.

Principal reasons for differences in practice were attributed to topographic conditions, the method employed for ultimate disposal, administrative practice and budget allotments. In summarizing the discussion, T. R. Kendall, engineering editor, *The American City*, stated that the practice of requiring garbage to be wrapped is being more widely adopted, chiefly due to the increasing number of incinerator plants.

Abandonment of open truck methods of garbage collection in favor of closed trucks provided with com-

pacting devices was said to be a trend in municipal practice.

Planning in small cities

City engineers are the real planners in most municipalities, said Frederick R. Storrer, city engineer, Dearborn, Mich., and it is their responsibility to see that planning efforts are carried beyond the stage of wishful thinking. While three-quarters of the 918 cities in the 10,000,-200,000 population class provide for planning or zoning agencies only 4 per cent of this number provide funds for their operation; this means, stated Mr. Storrer, that the execution of planning activities rests primarily upon the engineer's shoulders.

From the engineer's point of view planning is not a means toward the city beautiful so much as it is a device for developing the city practical. It involves among other things, the economic design and construction of essential services such as water supply, sewers, parks, transportation and transit facilities. It goes beyond mere technical development of these services, however, and it should include essential plans for financing these improvements.

Organizing for floods

The manner in which a major city administered public services during the January 1937 flood catastrophe was described by J. Eugene Root, director, department of public works, Cincinnati. When the flood stage suddenly reached 80 ft., and inundated about 9,600 acres in the city on January 24, the mayor appointed a general committee of fourteen members to direct and coordinate all activities during the week-long emergency.

Before the water plant was put out of commission steps were taken to secure hauling equipment (tank trucks, street flushers, etc.) and select nearby sources of well supplies. Distributing points were located in 65 places around the city. During the 10 days' emergency water service period there was hauled an average of 350,000 gal. per day.

Waste collection and disposal continued daily. Special service was rendered to 26 Red Cross refuge stations. In order to operate the incinerator plants, water was hauled for damper cooling and at one time for steam; since there was no power, burning was carried on with natural draft only.

Establishing utility rates

Suggestions and practice in the establishment of rate charges for municipal utilities were outlined by Albert P. Learned, assistant engineer, Black & Veatch, Kansas City, Mo., who stated that such charges should be equitable, reflect the benefits of diversity between classes of users, be simple and yet promotional. Furthermore, they should only be high enough to cover the costs of service.

Establishment of a rate schedule for a gas utility will depend on whether it is a manufactured or a natural gas system. In place of an investment of from $75 to $125 per customer in a natural gas system the manufactured system costs from $175 to $275 per customer. Domestic consumers in the latter use from 20,000 to 40,000 cu.ft. of gas per year as against 70,000 used by the average natural gas customer.

It was suggested that the minimum monthly charge be kept at practically $1.00 and that the first one and two and perhaps three thousand cu.ft. charge be adjusted to carry the capacity and customer costs of service. The excess over the third thousand shall be designed to provide revenue for carrying the commodity cost.

About 30 states have adopted legislation permitting municipalities to charge for sewer service by direct periodical billing, or "sewer rentals."

A recent study of 125 cities showed that 22 had a uniform annual flat rate per connection varying from $1 to $12; 16 places based sewer rentals on a per-cent of water revenue and these varied from 10 to 100 per cent; 30 cities had a flat or graduated scale based on the type of sewer connection; three base charges on the type of buildings; and over 50 places upon the number of plumbing fixtures or outlets.

In the water works field it is almost universal practice to charge on a volume basis said Mr. Learned. Practically all schedules are in block form with the minimum charge based on a certain consumption in cu.ft. or gal. per month.

If hydrant rental rates reflected the entire charge properly allocated to fire protection use, they would, in most cases, be higher than they are today. They have been generally accepted at an annual rental of from $40 to $100; the charge amounts to about $1.00 per capita per year.

Birmingham water supply

The unusual situation in Birmingham, where the city is building a water supply system purely for industrial users, was described by J. D. Webb, city engineer, Birmingham. The project, costing nearly $6,000,-000, includes an impounding reservoir, a diversion reservoir, 44 mi. of supply and distribution piping and a chemical adjustment plant.

Birmingham has an ample water supply for domestic purposes but this falls far short of meeting industrial demands. Because there are no nearby sources of water suitable for industrial use it was necessary to go to the Blackburn Fork of the Warrior River. Here an earth and rock-fill dam is being constructed to impound 22 billion gallons of water. The dam is 185 ft. high and 1,500 ft. long. Plant capacity is designed on the basis of 60 m.g.d. demand.

The work is being financed with a federal grant and loan. WPA is furnishing $2,278,000 and PWA furnished a loan of $3,430,000. The loan is backed by city revenue bonds which will be retired by revenue derived from operation of the system. Contracts already signed with industries guarantee the sale of 13 m.g.d.

A novel feature of the dam design is the provision of an emergency spillway in addition to the regular spillway. The former consists of a concrete weir with a 10-ft. earth fill above it. Should the water in the reservoir top this earth (a possibility in the so-called 500 yr. flood) it will wash out and the spillway will come into action to reduce the water level 4 ft. below normal elevation.

The chemical control plant, located below the distribution reservoir (which is near the city and holds 65 m.g.) will provide pH adjustment and chlorination. To prevent inadvertent use of this water for drinking purposes it will be super-chlorinated; this will make it disagreeable in taste and thus warn consumers, and will also assure sterilization.

FIG. 1. THE IDEAL LIGHTED HIGHWAY WILL HAVE NO DARK AREAS AND NO GLARE FROM ANY SOURCE.

Designing Roads for Lighting

by C. A. B. HALVORSON

Consulting Engineer, General Electric Co., Lynn, Mass.

Successful lighting requires the road engineer to produce a surface that is easy to light and produces the minimum of glare under all conditions

PLAIN INDICATION has been found in laboratory and field studies of highway lighting (*ENR*, Aug. 5 and 19 and Sept. 2 and 23) that the design of the road and particularly of its superficial surface plays an important part in the ease with which it can be lighted. This is specifically the task of the highway engineer; the lighting engineer can directly accomplish little. But he can point out the principles of lighting that must be considered and by tests indicate some of the requirements of road surface for lighting. These are the purposes of this article. It is presented as information.

In developing the information the following order is logical: (1) Statement of design requisites; (2) Feasibility of meeting these requisites; (3) Light reflectivity of various surfaces. In developing the last information illustration from original tests is extensively used.

Design requisites

In highway design, with night use predominately in mind, the desired requisite is that the highway and its immediate suroundings shall appear to the eye as an illuminated picture. Generally, it may be said that the art of street and highway illumination, due to increased knowledge of the subject and to more efficient light sources and luminaries of greatly improved design, has advanced to the point where roadways of any type and width can be adequately lighted under all conditions of weather, but in all cases the question of economics becomes a major consideration. If ideal pavement surfaces were always available, and other conditions favorable, lighting for safety could be supplied at the minimum cost. The conception of an illuminated picture is indicated by Fig. 1 illustrating a modern highway with modern lighting. Note that the gradation from bright to dark areas occurs without extreme contrasts. Such a field of vision is comfortable to the eye and not fatiguing over long periods because the eye is not called upon con-

tinually to adapt itself to varying conditions of brightness.

To realize the kind of illumination indicated by Fig. 1, three requirements are necessary:

1. That the highway be lighted with fixed luminaries with an entire absence of glare from: (a) the luminaries themselves, (b) oncoming automobile headlamps directly, (c) wet pavement glare from headlamp reflections, (d) misdirected floodlights and unshaded sources of light at roadside stands, gas stations, etc., (e) all inappropriate and unshaded street luminaries within the field of view employing lamps with "point" sources of light and as premised above, (f) in general the highway and its immediate surroundings shall appear to the eye, as an illuminated painting; i.e., with the eye adapted to relatively low intensities of light and illumination over relatively wide side areas (Fig. 1).

2. That the pavement surface be designed and composed of light-reflecting materials having certain components of reflection and diffusion which shall remain practically the same, wet or dry. In other words, the pavement brightness produced by the applied illumination shall be substantially the same in value and character under all conditions of weather except snow and ice. Snow and ice, however, need not necessarily negatively affect certain desired lighting results described in this article. In addition, the pavement design for artificial light shall mitigate pavement glare under sunlight.

3. That, in general, paving surfaces and textures that are favorable for lighting in both dry and wet weather will not appreciably increase the cost of the highway construction or its maintenance but, on the other hand, will greatly reduce the cost of adequate lighting. It is assumed in this consideration that the usual provisions for safety in daytime travel will suffice for the highway designed for adequate lighting. These are traffic lane markers and sloping curbs of stable, highly-contrasting material to aid in defining the paths of travel, especially in fog, and signs designed for easy reading and high visibility under the general illumination. It is, of course, desirable that traffic "friction" be eliminated as much as possible in accordance with the advanced ideas of recognized experts in highway construction. That is, the highway shall be of the limited or one-way type, with opposing traffic physically separated and berms to be provided for disabled vehicles. Also, it is important that light-colored safety rails or fences be placed at fills and on the outside of curves that are without background. At particularly hazardous locations the conventional diagonal black stripes on contrasting background seem to possess merit.

Glare elimination is first

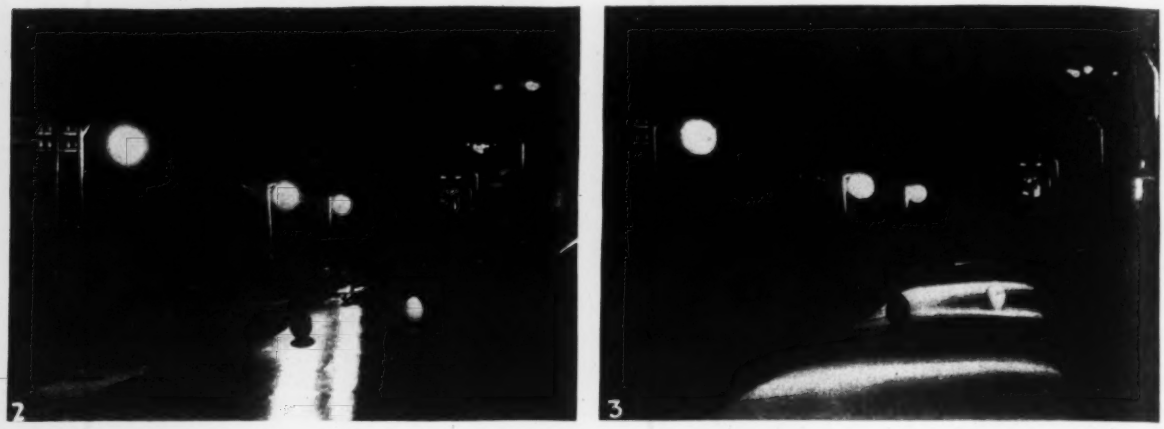
In reading the requirements just outlined the first question is: To what extent are they feasible in general highway-design practice? Let us analyze glare first. Following the enumeration given above we have:

(a) Glare from Luminaries—The development of more efficient light sources of both the vapor and incandescent type and the design of highway luminaries has advanced rapidly, in the past few years. Now there are available scientifically-designed luminaries, employing 10,000-lumen sodium-vapor lamps which are of relatively low intrinsic brilliancy due to the large surfaces emitting light; also new Mazda-lamp luminaries in which the "point" source of light is cut off from view at the higher angles are fast coming into use. Both systems properly installed are sufficiently free from objectionable glare and produce high visibility.

(b and c) Glare from Headlights—Elimination of both direct and reflected glare from headlights simply means, if the highway reasonably meets the requirements of design and construction as indicated herein, and is adequately lighted with modern luminaries fixed in position along the highway, that bright headlamps are unnecessary and undesirable and beams should be turned down and dimmed when the car enters the highway. In this connection, consider the cases of the Holland Tunnel, with two-lane one-way traffic, and other vehicular tunnels such as the Sumner two-lane two-way tunnel in Boston. In both, the lighting of all vehicular lamps is prohibited, since adequate lighting from fixed luminaries is provided twenty-four hours of the day. Due to a combination of favorable circumstances, with regard to the weather, driver inspection, pedestrian traffic, elimination of "friction," etc., in addition to adequate illumination, accidents in these tunnels are at a minimum. However, in spite of these sheltered roadways, it is true that wet pavements are sometimes found, but with the elimination of all automobile lighting and the placement of the luminaries high and flush in the walls all glare of the kinds enumerated above is eliminated.

(d) Glare from Miscellaneous Light Sources—No one who drives at night on our highways and has given the matter thought can do otherwise than criticize the prevalence of glare, with accidents on every hand, due to the misapplication of light. These conditions must be rectified sooner or later, and it is obvious that the remedy lies first of all in education and then in administrative action. The federal government, for example, lost no time in prohibiting the promiscuous use of searchlights for commercial purposes when it was found that their beams interfered with the operation of the airlines and endangered the lives of those flying by night.

(e) Glare from Street Lamps—Inappropriate street lamps are one source of glare reaching the eyes of drivers on highways passing through towns and the outskirts of cities, that can be attributed largely to the tremendous and necessarily rapid growth of the automobile-transportation system. Highway lighting is not new and many miles of what was at the time considered adequate lighting were installed along interurban roads and on some rural highways in the horse and buggy days. In 1914 an organized effort was made to improve these systems to meet the needs of the new vehicle of transportation and much progress was made, lamps of 60 c.p. (600 lumens) or less in open reflectors being replaced with 250-c.p. (2,500 lumens) lamps operated in light-controlling luminaries that conserved the light and distributed it in highly-concentrated beams evenly over the road surface. Funds for this purpose then, as now, were scarce, and the lighting engineers were obliged to make the light flux go a long way, with the result that spacings of several hundred feet with a relatively low mounting height were the rule, rather than the exception; spacing-mounting height ratios of 10-16 to 1 were common.



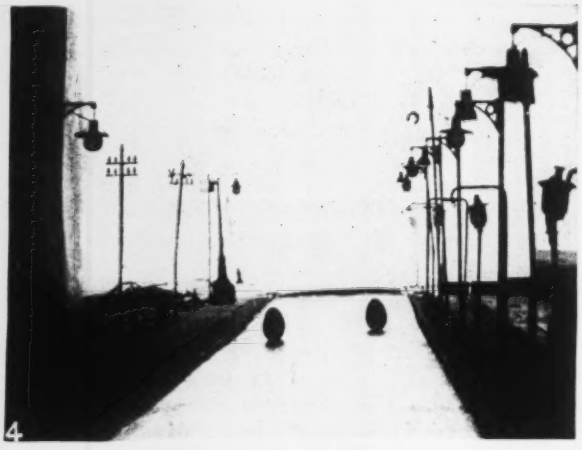


Fig. 2-4. The effect of the direction and angle of light varies greatly with changing conditions of the pavement surface.

Projecting light beams of high candle power, with relatively small sources of light, at such great distances with the imperfect tools of that day, inevitably caused glare, and many of these old systems are still in use. In many cases, progressive municipalities have installed modern systems of street and highway lighting, using sodium luminaries or an equivalent incandescent lamp system, for the protection of their citizenry, but by some the struggle to maintain adequate illumination on ever widening highways, carrying an ever increasing volume of traffic, oftentimes of little consequence locally, was given up, the final conviction being that the cost of lighting such stretches adequately was properly a function of the state, the same as the maintenance of the highway. Obviously where glare exists remedial action should be taken by the state.

Design of surfaces

We come now to the major and most difficult requirement of designing a road surface of the best kind for lighting. The pavement itself is a most important factor in the design of adequate and economical highway illumination. Paving materials now in common use vary in light reflectivity from less than 4 to more than 30 per cent—so that with equal illumination pavements of similar surface composition but differing only in color vary in apparent brightness by as much as a ratio of one to eight. White traffic paint commonly used to mark traffic lanes may reflect as much as 80 per cent of the light falling upon it. White cement, used for pavement inserts and curbs, also reflects a relatively high value of light.

In addition to the wide variations in reflectivity, most materials used in paving vary greatly in the character of their reflection. That is, some reflect diffusely like new snow or even cinders while some reflect specularly as polished metal reflects, but as a rule the two types of reflection are found combined to a greater or less degree in all types of pavement under various conditions of weather. With but one or two exceptions, paving materials and pavements change their reflection coefficients and characteristics greatly when wet. Finally the brightness uniformity of various types of pavement varies greatly with the specific intensity, direction and angle of the light, i.e., the light distribution, mounting height and transverse placement of the luminaire with respect to the pavement.

In view of these great differences in the behavior of existing types of pavements under light, one naturally wonders how visibility is affected by these factors alone; that is, how great really is the difference between black and white, and the difference between day and night? To study this question tests were made on a model road and the following discussion and illustration are based on these tests.

Let us first of all view a pavement (Fig. 2) in miniature simulating a wet, smooth black surface. The model is built to scale and represents a roadway 30 ft. wide between curbs. However, the illumination factors, affecting visibility in the photograph are the same as for a highway of full size. The overall reflectivity of the pavement is minimum but the specular brightness is maximum and typical of wet pavements found in practice. The lamps are equipped with diffusing globes and the illuminating effects are those of 6,000-lumen lamps.

There are three unshaded luminaries on the left hand side of the highway, and six on the right hand side that are shaded. The latter have the halves of the diffusing globes toward the observer (camera) painted with lamp black so that one-half of the light is absorbed. The light (lumens) falling on the pavement is the same on either side of the road, but on the right side, all the light from the six lamps is away from the camera, therefore they,

themselves are practically invisible. The two test objects, placed on the pavement for comparison, are of the same high reflectivity. Yet, the one on the left is revealed as a pure silhouette (black) against the elongated image of the adjacent lamp reflected in the pavement, thus the pavement appears bright (white) wherever it is between the eye and the sources of light. The object on the right appears white in contrast with the same pavement, being illuminated by light reflected from the adjacent lamp and directed away from the camera but note that the pavement appears dark due to the direction of light striking the wet surface. Obviously, a dark object in this same area would be practically invisible.

Contrasts required

By this demonstration it is clear that vision in highway lighting primarily is accomplished by means of contrasts between objects and pavements. In the case considered above, each object is equally discernible for most practical purposes although the speed of vision probably is slightly different.

Fig. 3 is a view under exactly the same conditions as Fig. 2, except that a dry diffusing or *matte*-surface pavement of about 30 per cent reflectivity is simulated. In this case the pavement reflections from all nine lamps appear as transverse streaks instead of longitudinal bands as in Fig. 2. Fig. 4 shows the same pavement and test objects as in Fig. 2 with an illuminated background simulating a luminous cloudy sky limited in size and near the horizon. Both objects in this case appear as true silhouettes and bulk visibility is at the maximum. With this condition, color distinction to any appreciable degree simply does not exist. Such a method of illumination and discernment would be ideal for night driving on most wet pavements of existing types because usually a film of water submerges the pavement particles and changes the character of the reflection, i.e., causes the pavement to become specular without regard to its color, texture or light-reflection factor. Another striking thing in this view is the relatively great width of light source (extending across full width of background and two thirds of height of picture) required to fill the pavement with light to produce uniform brightness obtained by this means.

In an attempt to encourage thought along constructive lines the author presents tentatively, the development shown in Fig. 5. The groups of truncated conical cups, represent pavement "particles" of a type and size formed specially for their lighting effects both by day and night, wet and dry. The model right hand group is painted overall with Glyptal white traffic paint, impervious to water, to provide practically constant reflectivity. The first three rows of the right hand group (Fig. 5) hold water in the cups and on the floor of the pavement, but the outside sloping walls of the cones which are too large to be submerged, extend well above the water film; therefore, light is reflected from these surfaces even in wet weather as shown in Fig. 6c. Compare the wet half of the group with the dry and a very slight darkening is noticeable where water is standing; this is due to the surface reflection from the water of some of the light falling on the pavement from a source arranged as shown in Fig. 6a. If a pavement incorporating this type of particle was tried out in practice, an obvious improvement would be to provide drainage for the cup by forming a cleft in the rim. The darkening effects of water in some types of pavements seriously affect visibility where discernment most often depends upon the silhouetting of dark objects against a uniformly bright pavement.

In the left hand group (Fig. 5) the particles emergent from a dark floor are "printed" with Glyptal white traffic paint, of maximum reflectivity, especially suitable for the wear and tear of pavement service. Fig. 6 shows graphically the action of the light rays from the luminaire in a favorable location for producing the desired illumination results with this type of diffuse pavement. In this instance the lighting unit is shown placed at the outer edge of the berm of a highway having a 100-ft. right-of-way, with two 30-ft. roadways separated by a 20-ft. island. The

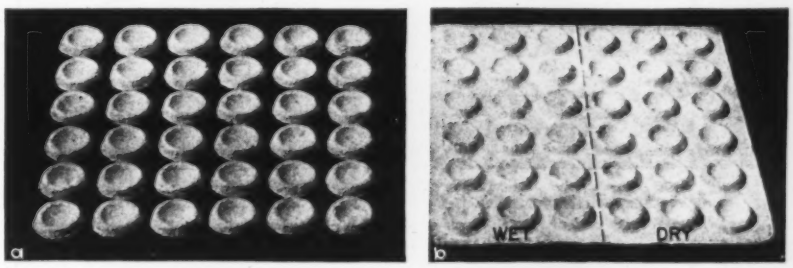


Fig. 5. In the study of reflection from pavement surface the use of truncated conical cups to represent surface particles has been found helpful.

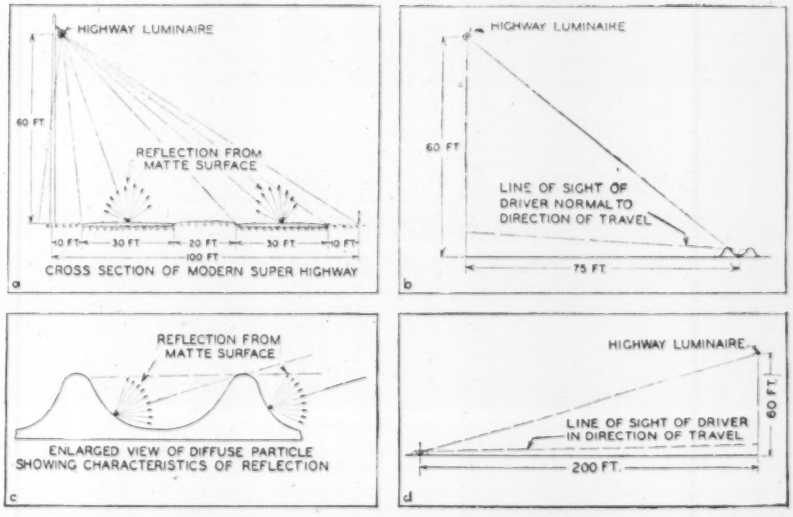


Fig. 6. The relation of light source to surface reflection is clarified by use of the cups shows in Fig. 5.

Fig. 7. Closely spaced sources of light are frequently employed in an effort to reproduce natural light. When wet this pavement produces effects similar to those in Fig. 2.

Fig. 8. Pavement characteristics are of major importance in light diffusion.

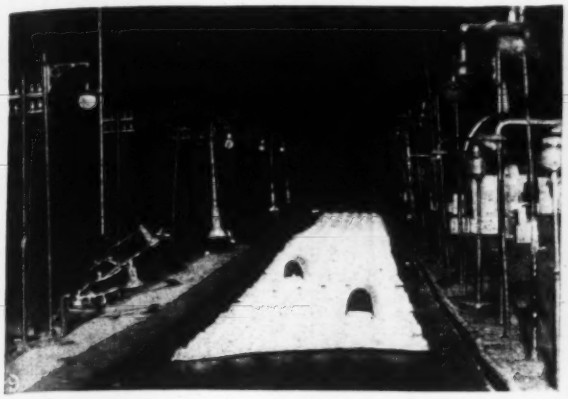
luminaire is mounted at about 60 ft. above the pavement. Even higher mounting heights would probably be justifiable from the viewpoint of economy since spacings longitudinally of the highway should vary with a spacing-mounting height ratio of about 4 or 5 to 1.

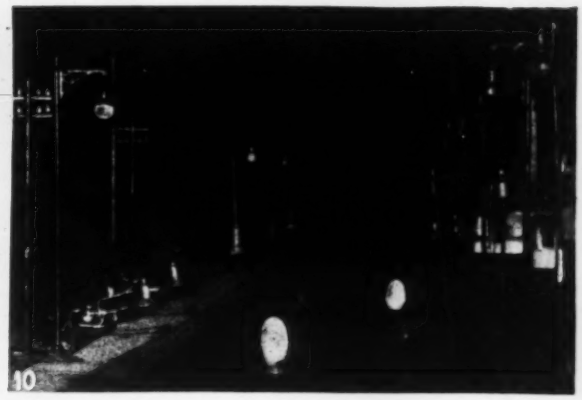
From the left hand group (Fig. 5) it will be seen that this modification of the proposed pavement when viewed nearby, i.e., when below the driver's eyes at relatively great angles, presents a great reduction of highly reflective surface or whiteness compared to the right hand group. Under a bright sun directly overhead the usual dazzling effect of a uniformly light-colored pavement is greatly mitigated by the areas of low reflection surrounding the highly reflecting cups and cones. With the sun facing the driver and in line with the pavement the cones and cups seen below the sun visor act as a light trap and their brightness is at the minimum for that particular component of the light. A somewhat similar action results from cross brushed concrete with the furrows running north and south. However, in the cases just decribed, light from the sky as a whole prevents the pavements from appearing black. At a distance, in the direction of travel, under artificial lighting of proper design, the brightness of the proposed pavement reaches a maximum at about 200 ft. and remains so at any distance beyond.

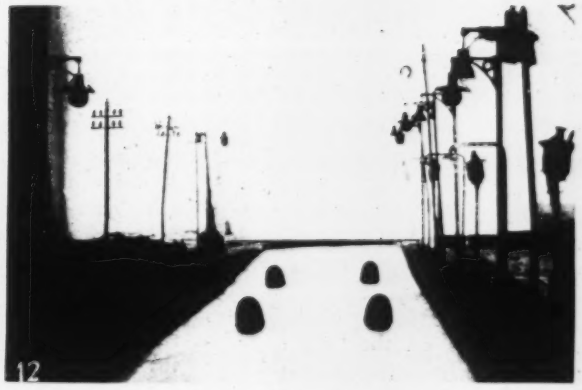
The performance of the pavement can be better understood from photographs with full size particles superimposed on the miniature highway used in Figs. 2 and 4. Fig. 9 shows a view with the light falling strongly from overhead on the cupped pavement and in the general direction of travel. Compare the brightness of this with that of the simulated wet smooth pavement (Fig. 10) where the lighting conditions are the same. Compare also the visibility of the four test objects, the same in each case, two of which are maximum white (Glyptal) and two maximum black (lamp black).

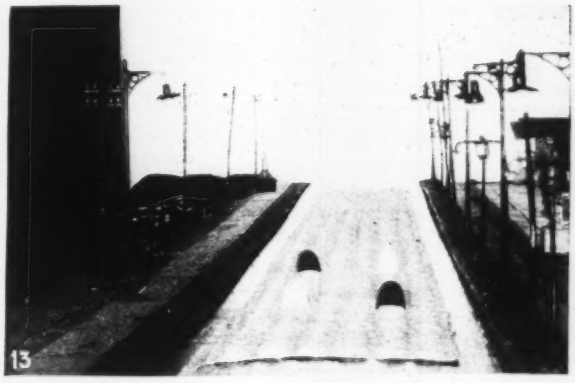
Fig. 11 shows a view of the pavement of Fig. 9 under the same conditions of light as Fig. 4 and 13. The striking thing here is the low brightness of the wet smooth pavement. Figs. 10, 12 and 13 illustrate the visibility conditions with respect to the four targets (2 black, 2 white) under different conditions of lighting but simulating in all cases a wet smooth pavement. In Fig. 10 the light is delivered as in Fig. 9 and the pavement appears dark as the light reflected from it is away from the observer's eye. The black targets are hardly visible against the dark background but the white targets reflect the direct light to the eye and are easily discernible against a dark roadway. In Fig. 12 the light is from the rear of the targets and towards the observer, resulting in the reflected light from the pavement reaching the observer's eye and the pavement appears bright with both the white and black targets visible as silhouettes against the bright pavement. In this case, color discrimination is lost. A combination of both the front and rear lighting (Fig. 14) simulates the conditions that obtain on a cloudy day with wet pavements of existing types.

Under such conditions, everything considered, discernment of objects usually found along the highway is probably at its best. Nature alone can accomplish such a result perfectly and only in the daytime by sky reflections, while at night man imitates by employing closely spaced sources of light (Fig. 5) to form the necessary background of luminosity and provide the required high levels of illumination on vertical surfaces to produce discernment by detail and color. The pavement (Fig. 7) when wet reflects exactly like the pavement in Fig. 2 except it is full of images of the light sources and, therefore, approaches daylight uniformity. A comparison of Figs. 7 and 8 shows how much simpler the lighting task becomes as the pavement characteristics improve in the reflection and diffusion factors. A comparison of Figs. 9, 11 and 13 with Figs. 10, 12









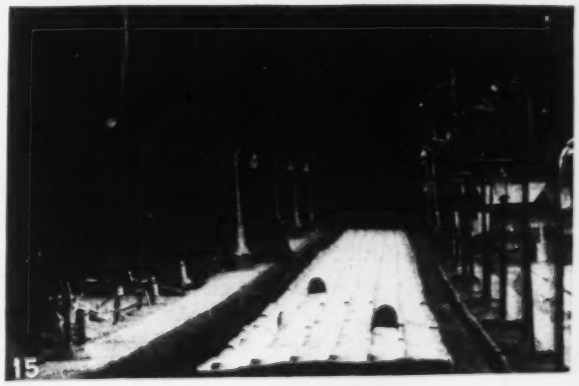


Fig. 9-15. Use of the cupped surface shown in Fig. 5 in contrast to smooth wet pavement serves to emphasize the importance of pavement surface.

and 14 respectively shows the differences in light reflecting characteristics of the cupped surface and the pavements in general use in which the specular component predominates. Similar lighting conditions exist in Figs. 9 and 10, in 11 and 12 and in 13 and 14 and permit a comparison of the pavement brightness and object discernment for the two types of pavement. In the case of Fig. 11, if the cups were full of water as in Fig. 5, the pavement would present much the same appearance as the one in Fig. 12 since the illuminated background simulating the sky would be imaged in the

pools and their surfaces in the aggregate would appear specular and uniformly bright.

Fig. 15 shows the proposed pavement with uniform illumination provided with the lighting units arranged as shown in Figs. 1 and 6 and the light filling to produce the effects shown in Fig. 7. Everything considered, with this type of pavement, visibility requirements of modern vehicular travel, both by day and night, seem to be reasonably met by the lighting schemes shown in Figs. 9 and 15. In the case of the arrangement in Fig. 9, the lighting may be more easily visualized by studying Fig. 6d; the luminaries used to take the photograph were arranged as shown to produce unidirectional illumination with uniform brightness of pavement to the eyes of the observer. So far as the visibility of the test objects is concerned, Fig. 9 seems to have some advantage especially in contrasting the white objects, while Fig. 15 seems to contrast the black objects more strongly. Either scheme is practical, but as most objects on the "highway designed for lighting" appear dark by contrast, the lighting of Fig. 15 is probably preferable.

Lighting engineers engaged in the design of street and highway lighting have evolved a certain technique which is based very largely on the assumption that pavements are moist or wet a certain percentage of the time, consequently their recommendations make allowances for weather conditions so far as practicable. Many paradoxical statements can be made in respect to the causes and effects of pavement brightness with highway lighting; for example, open-type macadam, may appear uniformly bright under rain due to myriad tiny pools of water and wet irregular surfaces which reflect images of the light sources in all directions. While dry open-type macadam possesses to a high degree the diffuse characteristics of the pavement shown in Figs. 5 and 6, its degree of reflectivity depends as in that case, upon the color of the particles forming the superficial surfaces.

Conclusion

From the above, it should not be inferred that revolutionary methods of pavement construction for highways must be developed, for such, in the author's opinion, are not necessary. His principal object in suggesting a novel pavement particle is to develop a hypothesis concerning pavement brightness which gravely affects the economics of highway lighting.

The crux of that phase of the highway lighting problem analyzed by the author in this article is that the lighting engineer can accomplish but little on his own to provide favorable pavement conditions from the lighting viewpoint. He must look to the paving industry for assistance and research to find durable and constant light reflecting materials for superficial surfacings since, after all, the surface alone is all that the lighting engineer is concerned with in pavement construction.

• • •

Seawater For Sanitation In Virgin Islands City

SALTWATER will be pumped from the Caribbean Sea to furnish a partial water supply to the town of Charlotte Amalie, Virgin Islands, as a result of improvements recently completed by the PWA.

Use of a separate supply of seawater for sanitation and fire fighting purposes is almost unprecedented in mainland United States and is practiced in the Virgin Islands because of the low precipitation prevailing there.

In Charlotte Amalie the water is pumped directly from the sea to a concrete tank 250 ft. above the town. From there it is sent through a network of underground pipes to the homes for sewage purposes, and to the water mains for fire fighting. The expanded system, which includes two new power pumps, will add a pumping capacity of 12,000 gal. per hr. It is expected that several hundred homes will install modern bathroom facilities as a result of the added supply. At present only about 200 homes are so equipped.

Since two years after American possession of the Virgin Islands, a continuous effort has been made to improve the water and sewage systems. There are few freshwater wells and with an annual rainfall averaging only about 45 in. it was impossible to install the ordinary sanitation improvements. The saltwater system was developed and originally served the King's Quarter area of Charlotte Amalie, but gradually has been extended over the most thickly populated sections.

Generally, the method has been successful, but it has created one major problem which engineers believe will be overcome on the new PWA job. Rust corrosion caused by the salt water has entailed constant replacement of the cast iron sewage pipes. The new pipes, which include over 7,000 feet of water mains and more than 5,000 feet of sewers, although of cast iron construction, have been lined with cement.

• • •

South African Building Continues at High Level

CONSTRUCTION ACTIVITY in South Africa is continuing at the high level of preceding months, and building plans already approved indicate that the construction industry should be fully occupied for several years according to reports from Johannesburg. The bulk of the work being done is in the Johannesburg and the Witwatersrand areas (the gold producing section of the country), but operations are quite satisfactory elsewhere throughout the country. A scare slump in the gold share market, together with expected government help promised to the small house builder, has occasioned some slackening in building, particularly in homes in Johannesburg, but up to this time values have not reduced materially. Johannesburg passsd 11,500 building plans calling for an outlay of £11,420,00 during the fiscal year ended June 30, 1937. Last year's total was £8,745,000. New buildings now planned will provide accommodation for an additional population of 29,000 Europeans and 16,000 natives.

Civil Engineers Meet with Canadians

Three papers on difficult construction in Canada form part of meeting marked by interest in soil mechanics and public-works policies

RETURNING the hospitality of the Canadian engineers, hosts to the American Society of Civil Engineers at Vancouver, B. C., in 1934, the society had the Engineering Institute of Canada as guest in joint meeting at Boston Oct. 6-8. The opening technical session, given over to the Canadians, had three papers on difficult construction operations in Canada. American papers were taken up on the second day, when six of the society's technical divisions were in session in four simultaneous meetings morning and afternoon.

The meeting was well attended, the total registration being 1,056. It was opened with brief addresses of welcome from Governor Hurley of Massachusetts, Mayor Mansfield of Boston, President Desbarats of the Engineering Institute of Canada, Vice-president Lupfer of the American Society of Civil Engineers, Albert Haertlein, president of the Northeastern Section of the Society, President Conant of Harvard and President Compton of M.I.T. Following these formalities Prof. Walter Gropius of the Harvard Department of Architecture gave an illustrated paper on "Cultural and Technical Background of the 'New Architecture,'" in which he traced the increasing influence of the present technical civilization upon forms of structures. Political origins, he said, have little to do with this trend. The rapidly advancing use of glass and the possibilities of low-cost mass production of standardized houses of the pre-fabricated type were touched upon. Progress has been slow in this country in the last-named activity, which is primarily a problem for industry to solve. Many striking designs and tenement housing layouts were presented, largely drawn from European practice.

About 300 delegates attended the students' luncheon on Wednesday noon, the presiding officer being Charles R. Gow of Boston. The speaker was W. T. Chevalier, vice-president, McGraw-Hill Publishing Co., who urged his audience of prospective engineers to broaden their horizons and study economic affairs with intensive interest; strive to reach independent conclusions; guard against extremists of every caliber; avoid rigidity in mental process; learn to work through other men and seek the task which is most congenial before weighing opportunities in financial scales.

Chief interest in the technical sessions was centered in the divisions of engineering economics and soil mechanics. The former division gave its meeting over to discussion of federal public-works policies and to advance planning for public works. The soil mechanics and foundation sessions, on the other hand, were concerned with technical problems, ranging from foundations to Mississippi River levees and the proposed Quoddy dams.

Fraser River bridge piers

A high-level, four-lane highway bridge is nearing completion at New Westminster, B. C., across the Fraser River, close beside a double-deck railway and highway bridge built 33 years ago. Its central span is a 450-ft. tied arch, continuous with 350-ft. side spans, at clearance height of 150 ft. above high water. The major piers, in sand bottom, were built as open caissons, in water 30 to 70 ft. deep with current ranging up to 8½ mi. per hr. in the June freshets. W. G. Swan, consulting engineer, Vancouver, B. C., described the construction of the piers and the difficulties caused by flood scour.

R. E. Chadwick, president of Foundation Co. of Canada, remarked that many millions have been wasted in carrying piers to rock when they might better have been stopped at a higher level, as here. He held that flood scour might have been decreased by shaping the caissons elliptically. As to vibration in placing concrete, he considers it should not be used in water exposure, as a less durable surface is produced than can be obtained by hand tamping.

L. E. Moore, consulting engineer, Boston, compared the pier-sinking difficulties met on the old and new bridge and concluded that in one-third century no material advance has been made in substructure engineering, probably because of over-conservatism. As to vibration he charged poor results to lack of good workmanship.

Wharf foundations

E. H. James, Montreal, reviewed recent port works at Halifax, including new shipping piers and reconstruction of a concrete pier shed destroyed by fire five years ago. The piers are designed for drafts up to 45 ft. Cellular concrete box units are the principal base type; where the water depth exceeds 45 ft. they are seated on a rubble mound. These units or "cribs" have been built in sizes up to 52x108 ft., 50 ft. high. Alumina cement was used extensively, though part of the capping wall was built of Portland cement in some cases.

J. B. Stirling, engineer of the contracting firm of E. G. M. Cape Co., Montreal, said that the cost in place of a concrete crib as built was less per cubic yard than that of a timber crib. The concrete crib construction was introduced into Canadian practice at Montreal, by J. S. Metcalf

Co. R. K. Hale, Public Works Commissioner, Boston, contrasted Halifax pier conditions with those of Boston, where the absence of rock leads to pile-and-bulkhead construction.

Large wood-stave pipe

The pressure conduit of the Ontardes hydro-electric plant of the Ontario Paper Co., on the north bank of the Gulf of St. Lawrence 200 mi. below Quebec, includes a 5,960-ft. length of 17½-ft. wood-stave pipe, said to be the largest in existence. The governing conditions of the design of the plant are in many respects exceptional, according to the description given in a paper by H. G. Acres, consulting engineer, Niagara Falls, Ont. The plant will serve a single customer, the company's paper mill 14 mi. away, hence will have a steady full-time load and must afford a high degree of reliability. The 35,300-hp. power unit, under 208-ft. maximum head, is therefore duplicated, the spare being operated regularly to heat one of the process-steam boilers in the paper mill.

Soils and foundations

By far the leading element of the technical proceedings, measured by attendance, was the subject of soil mechanics and foundations. After an opening statement outlining the proposed work of the division, read by Chairman Frank A. Marston, Boston, levee and embankment construction was dealt with by two papers, both contributed by members of the Engineer Department, U. S. Army.

Levees and embankments

Spencer J. Buchanan, associate engineer, U. S. Waterways Experiment Station, Vicksburg, in a paper "Levees in the Lower Mississippi Valley" outlined the gains in design and construction of levees achieved and in progress through the application of physical explorations and design analysis. This advance is particularly important because of the greatly increased dimensions of levees required under the present program of constructing to the 1927 section, for permanent protection to the valley. Machine construction with its resultant more rapid loading of the foundations also makes scientific analysis more important.

Under past practice, Mr. Buchanan concluded that foundation changes were inevitable, and the development of the ultimate levee section at points having bad subsoil was dependent on "actually producing failures of foundations and later repairing them". The new analysis and design methods eliminate this necessity, by making it possible to design to fit the observed and measured subsoil condition. Mr. Buchanan also believes that analysis will permit of using steeper levee slope on the land side in many cases.

In discussion, Charles Senour, principal engineer of the Mississippi River Commission, at Vicksburg, expressed the opinion that soil mechanics design cannot accomplish much in aid of levee construction. As levees are actually built without selection of materials, without compaction, by placement in irregular masses and lumps rather than in layers in order to obtain a very low cost (18¾ cents per cu. yd.), any attempt at precise design is fallacious and provision for an ample width of levee is a desirable safety element. For general use, the 1927 levee section has proved satisfactory and will probably not be subject to much change. However, soil mechanics offers the only rational approach to the design of special sections crossing old channels filled with sediment, where flattened slopes are in order.

T. T. Knappen, consulting engineer, New York, gave observations based on five years' experience in charge of 200 miles of levee of the lower Mississippi system. Sloughing has never been observed with landside slope as flat as 1 on 7½, but Mr. Knappen asked why the slopes should not be made steeper if drainage is provided to hold down the toe of the saturation line. With careful selection of material and full hydraulic analysis, he believes this can be possible.

Quoddy rockfill dams

The problem presented by the design of the proposed rockfill dams to close off Cobscook Bay for the Quoddy tide power project, was discussed in a paper by B. K. Hough, Jr., associate engineer, U. S. Engineer office, Ithaca, in a paper "Stability of Embankment Foundations". The dams in question were to be built in water of a maximum depth of 120 ft., underland by material that borings showed to be principally a soft clay. To place a rockfill dam on this base necessitated either making it five to ten times as wide as the minimum section of a dumped rockfill would require, or else allowing the rock to squeeze down into the foundation sufficiently to find adequate bearing.

To decide between the two courses, borings to determine the physical nature of the soil were followed by model tests to learn just how a soft foundation would fail under excess embankment loads. These tests were made partly with gelatin foundations, by photo-elastic study, and partly with clay foundations.

The conclusion was that "embankment settlement resulting from shear failure and lateral displacement of the foundation material will take the form of so-called heart-shape". It was concluded that building the dams to squeeze down into the foundation would be cheaper than building a base wide enough to carry the load without settlement.

S. C. Hollister, Cornell University, and L. F. Harza, consulting engineer, Chicago, briefly discussed the paper. Mr. Harza pointed out that we know much more about the analysis of embankments than about foundations under embankments. He pointed out that foundation failure would crack the embankment, which would not be permissible in a dam; in the case of Quoddy dams this cracking might be unobjectionable, but it would probably not be safe elsewhere.

A novel building foundation

A large office building in Boston has been built with carefully studied provision to safeguard against differential settlement. The case was outlined in a paper by Prof. A. Casagrande, Harvard University. Compressible subsoil and unequal loading due to a heavy central section were the controlling factors.

The architect's first design, using caissons placed directly under the columns, showed by analysis that excessive differential settlements would result. A heavy truss foundation was then considered, but was rejected on

the score of cost and interference with architectural functions. In the design which was finally carried out, the loads were rearranged by means of heavy beams and slabs resting on groups of caissons in such a manner that the differential settlements were considerably reduced. In addition, the foundation walls were redesigned as heavy trusses to reduce the differential settlements of the exterior walls to a very small amount.

A permanent benchmark was sunk to a depth of 140 ft. through the compressible clay into the hard substratum. Over 100 settlement observation points were installed in the basement. Observations will extend over many years for the purpose of learning more about the effect on settlement of the action of horizontal drainage within irregular deposits of clay; the relation between the compressibility of the really undisturbed soil in the ground and the compressibility of so-called undisturbed samples tested in the laboratory; third, the stress distribution in the ground as affected by sand and gravel strata within the compressible clay stratum.

In discussion Donald W. Taylor, research associate at Massachusetts Institute of Technology, and Frank A. Marston, consulting engineer, Boston, emphasized the necessity of accurate and complete settlement observations and stressed the uncertain factors in settlement analyses. Mr. Taylor particularly commended the method used in presenting the results of this settlement analysis by a range within which the actual settlements are expected to lie.

An excellent general review of soil mechanics knowledge as applied to several specific fields was presented by Professor Glennon Gilboy of Massachusetts Institute of Technology. He said that in spread foundations the concept of a definite unit bearing value has been displaced by the teachings of the new science. Equally large changes of view and method have resulted in the fields of pile foundations, lateral earth pressure and earth dams. Professor Gilboy instanced cases of abnormally high bracing pressures in sheet pile cofferdams driven as excavation proceeded, a condition not revealed by the old time earth pressure theories; and in this connection he pointed out that engineers and contractors have many opportunities to make important additions to knowledge by pressure measurements and other experiments in construction. In earth dams he emphasized among other things that some engineers following old views believe that the position of the saturation line depends on the permiability of the dam and can be kept below the toe, neither of which views is warranted, as modern experience and soil science show. He also pointed out that the old aim to make dams watertight largely lacks justification.

Professor P. C. Rutledge, Purdue University, said in discussion that modern soil mechanics recognizes that soil usually is not homogenious, not isotrophic, and often not elastic. In its best application, such factors as stratification, sheer resistance and the like are given attention. The present tendency is away from reliance on complicated solutions of soil stresses. Professor D. M. Burmister, Columbia University, suggested that soil gradings are capable of being classified in a limited group of types, and that these types may be correlated with density.

Boring and sampling

A topical discussion of boring and sampling led by H. A. Mohr, Raymond Concrete Pile Co., Boston, brought out the fact that views on the value of undisturbed versus disturbed samples still differ considerably. It is recognized that no method of obtaining undisturbed samples exists, but specimens obtained with a modern sampling tube or a drive sampler are universally considered far superior to specimens that are "completed disturbed" as those furnished by an augur. Mr. Mohr declared that no method of boring and sampling can give complete information as to the subsoil, and that the latter is obtained only by the contractor as he excavates. Professor G. Tschebotareff, Princeton, acknowledged that so-called "undisturbed" samplers still have many defects that remain to be remedied. S. M. Dore, Boston, said that when a prospective borrowpit is to be sampled, this is best done by opening up cuts. However, drive samples have proved to be remarkably representative of the material actually encountered.

Thomas E. Stanton, Sacramento, reported that samples taken by a sampling tube slightly larger than the cutter, have proved satisfactory, by giving results that checked closely with those found in construction.

Professor I. C. Crosby, consulting geologist, Boston, reported that in Georgia mining regions test pits of 28 in. diameter, are dug as much as 50 ft. deep, and that such pits stay open indefinitely in the clay-sand-soil of the region.

City planning

At the meeting of the city planning division, Justin R. Hartzog, consultant to the New Hampshire Planning Commission, Cambridge, Mass., in a paper on "Regional Recreation Plans to Serve Urban Populations" argued for large-scale planning of recreation facilities for a region within a radius of one day's transportation from the population center. Commenting on this proposal, Arthur W. Dean, chief engineer of the Massachusetts Planning Board, Boston, said that this radius is excessive, as most urban families requiring to be provided with recreation facilities do not have an automobile. Recreation planning should be coordinated with transportation facilities, he said, to be successful.

Frank H. Malley, Boston Planning Board, Boston, in a paper "The Value of a Thoroughfare Plan" told of the thoroughfare plan developed seven years ago by the Boston Planning Board. Of the $90,000,000 that this plan will cost, about $30,000,000 has been spent so far.

Mentioning the safety problem, Mr. Malley remarked that "Built-in safety in our streets and highways will be one of the important means of lessening the mounting toll of motor vehicle accidents," and said that "a highway is no safer than its intersections." Leslie G. Holleran, New York, in a written discussion emphasized the effect of parkway or freeway systems in raising land values, as compared with the effect of ordinary highway and street systems. It will be many years, he asserted, before highway planners catch up with requirements.

Boston harbor pollution

An exhaustive paper on "Studies of the Pollution of Boston Harbor and Its Tributary Waters," by Arthur D.

Weston, chief engineer, and Gail P. Edwards, laboratory coordinator, Massachusetts Department of Public Health, opened the sanitary division session. The paper recorded data on the distribution and chemical content of putrescible matter in the waters of the harbor and adjacent shore areas as related to the discharge outlets of the sewage system, reviewed the service of the Boston and metropolitan disposal facilities, and indicated the desirability of extensive sedimentation treatment.

The authors concluded that the amount of putrescible matter discharged into the harbor is not yet sufficient to cause a nuisance resulting from the depletion of oxygen. Objectionable sleek areas are often present, however, and at times grease and solids reach the shores, together with overflows from trunks and laterals during heavy run-offs. Except near sewer overflows and a few discharge points, bacterial studies do not indicate pollution of bathing waters to a degree dangerous to health, but the nuisance from sleek and floating solids makes a change in present disposal methods very desirable. It is estimated that the total cost of treatment to 1955 by suitable works supplemented by barging solids and grease to sea, including sedimentation and skimming would be $6,207,000 for the Boston main drainage system, $12,729,850 for the north and $13,583,000 for the south metropolitan systems, respectively. Extension of outlet systems further to sea appears unwarranted under present conditions and unless accompanied by preliminary treatment would probably give unsatisfactory results.

In discussion, E. Sherman Chase, Metcalf & Eddy, Boston, cited the lack of progress in utilizing sewage for fertilization in the past 60 odd years. He commended the authors' work and urged that anti-pollution projects better deserve taxpayers' support than "many of the imposing monuments to vanity" now under construction. Richard Gould, New York sanitation department, sketched the recent rapid advance in sewage disposal in relation to New York Harbor, with its severe conditions.

Prof. Gordon M. Fair and E. W. Moore, Harvard University, in a paper on "Decomposition of River Deposits", presented an extended laboratory study of a sample from a river bottom. Observations covered 145 days, and biochemical changes were studied mathematically. They concluded that the rate of benthal decomposition of organic matter in streams, contrary to the belief of most engineers, proceeds much more slowly than the aerobic decomposition of polluted water and suspended matter or the anaerobic decomposition of sewage sludge that has been adequately seeded. Commenting, Langdon Pearse, Chicago Sanitary District, emphasized the importance of ascertaining the oxygen demands of river areas per thousand sq.ft. per day in studying sludge decomposition in the field. R. R. Ribal, Oakland, Cal., stressed the hazards of sewage overflows, and H. W. Streeter, Cincinnati, cited the value of freshets in preventing accumulation of deleterious sludge. He urged more study including the effect of industrial wastes.

Marine borers

"Recent Developments in Marine Borer Studies", a paper by William F. Clapp, consulting biologist, Duxbury, Mass., inaugurated the waterways division session. The speaker cited many instances of recent northward invasion of marine borer from lower New England and points south, as evaluated by test board studies and evidenced by attacks on wooden structures. Over 200 test boards are now in service. The teredo is confined largely in New England to areas south of Cape Cod, but limnoria are widespread. Teredo Navalis has been found as far north as Searsport, Me. In the past two or three years about $5,000,000 has been expended on repair work due to marine borers in Boston Harbor.

F. L. Sellew, Massachusetts Department of Public Works, cited the value of creosoting and of leaving the bark on piling as a retardant of borer attack. The department is considering the establishment of regulations for types of construction in tide water to retard and resist borer action. A. H. Morrill, chief engineer, Boston & Maine R.R., said that marine borers now (after 6 years) infest the piling in the Portland Terminal to the extent of about 20 per cent. Red oak piles have given better results, but timber structures in many areas should be protected.

Maj. R. L. Miller, Construction Quartermaster U. S. A., described the construction of a sheet steel bulkhead and associated work at the Boston Army Base to prevent marine borer action. About 30 per cent of the original section of piling examined had been eaten away, and nearly $1,000,000 was appropriated by the federal government to remedy the situation. The base was built in 1918-19 and cost about $25,000,000. Extended data on labor costs and a review of the major construction problems and their methods of solution comprised the bulk of the paper. No alarming borer action has been seen since completion of the job in March, 1936.

Prof. C. M. Spofford, Boston, read a paper on the "Reconstruction of the Deck and Footings of Commonwealth Pier at Boston." Investigation of marine borer activity showed that from 1925 to 1934 the proportion of piles affected rose from 55 to 92 per cent. About 10 per cent of the piles were more than one-half gone and six piles had been reduced from 10 to not over 3 in. at the mud line. Piles having the original bark were invariably in good shape. Most of the damage was caused by limnoria. In the reconstruction work, steel bearing piles were driven in clusters of four to bedrock, the upper portions being driven in caissons later filled with concrete above a layer of sand and gravel forming a bottom. The head house foundations were protected by driving a sheet steel pile bulkhead outside and filling the space between this and an existing sea wall with cinder concrete. Creosoted yellow pine fenders were used on this job in the belief that these would outlast available oak piling.

Mapping in Massachusetts

The surveying and mapping division gave its attention to the development of mapping and land registration in Massachusetts, Clarence B. Humphrey presenting an interesting record of the development of land registration in the period since the first royal grant to the Plymouth Co. in 1608, and E. C. Houdlette, giving a similar review of the establishment of the Massachusetts system of rectangular coordinates, going back to the start of mapping in Massachusetts in 1829.

A report of the Engineering Economics Division meeting will be published next week.

THE WEEK'S EVENTS

Continued from page 659

Sanitary Meeting In North Dakota

Record attendance at ninth convention of North Dakota Water and Sewage Works Conference

The ninth annual convention of the North Dakota Water and Sewage Works Conference at Mandan Sept. 27-28 was credited with being the most successful meeting of that group since its inception. Registration this year reached the hundred mark and attendance at the dinner and banquet was 185. New officers elected for 1938 are: S. G. Calvelage, president; William Nordley, vice-president; M. D. Hollis, re-elected secretary-treasurer.

After tracing the development of public water supply systems, Prof. Jack J. Hinman, Jr., associate professor of sanitation at the University of Iowa, said in his paper on "Modern Waterworks" that important problems demanding present-day consideration are improvement of chlorine residual tests, better filter washing, pressure aeration, recarbonation, and the use of anthracite filter media.

Frank C. Foley, assistant state geologist, discussed the application of earth problems. Mr. Foley described experiments in determining the direction, depth and extent of underground veins of water obtained by correlating electrical data with known well logs. Although the computations have not yet been completed, sufficient evidence is available to indicate that the electrical method will be of value in locating replacement or supplementary water supplies.

In discussing water tank and reservoir repairs, F. O. Malloy of F. O. Malloy & Co., pointed out the value of electric welding in repairing pitted sections of steel tanks. He stressed the importance of selecting protective paints with relation to the particular water being used and said that best resistance to freezing and to corrosion was obtained from coverings which remain somewhat plastic and do not require excessive drying time. He also discussed methods of preventing freezing in reservoir risers and standpipes.

Myron H. Atkinson, executive secretary of the North Dakota League of Municipalities, spoke on "Civil Service for Water and Sewage Works Operators," and a resolution recommending that water and sewage works operators be included in municipal civil service systems was adopted by the conference. Functioning of the water conservation commission was described by Kenneth W. Simons, member of the state water commission.

Wesley E. Gilbertson, assistant sanitary engineer of the state department of health, spoke on rural sanitation, and M. D. Hollis, director of the division of sanitary engineering in the state department of health, discussed stream pollution and public health.

• • •

Tennessee City Permitted To Use TVA Power

A three-judge federal court, in dismissing Sept. 27 an injunction suit brought by the Kentucky-Tennessee Light & Power Co. which sought to prevent the city of Clarksville and the TVA from entering into a power contract, lifted a restraining order which was originally issued in state chancery court.

Dismissal of the suit leaves the city free to go ahead with plans for purchases and distribution of TVA power.

• • •

Structural Study Planned At Acetylene Meeting

A number of papers of interest to civil engineers have been included in the program of the annual convention of the International Acetylene Association which is to be held in Birmingham Nov. 10-12. At the first technical session, devoted to "speeding manufacture and construction with oxy-acetylene welding", a paper will be presented on the spot-welding of railroad rails by R. R. Cummins, Central of Georgia Ry. and three papers, by O. B. McLaughlin, Freeport Sulphur Co., Lee Hopkins, John W. Danforth Co., and C. L. Lane, of the Walworth Alabama Co., will discuss welding of pipe lines.

The second technical session on the question of "how and why to use oxy-acetylene cutting" will include a paper on oxy-acetylene cutting and fabrication by A. E. Gibson, president of the Wellman Engineering Co., and a paper on the cutting and tempering of structural steel, by H. H. Moss of The Linde Air Products Co.

San Francisco to Vote On Sewer Bonds

Voters of San Francisco will pass on the issuance of a $5,000,000 sewer bond issue at the election Nov. 2. Proceeds of the bond issue will be used for the extension of existing trunk sewers, for additional sewage treatment plants, and to replace existing trunk sewers that are beyond repair.

The city director of public works has been endeavoring for some time to develop a comprehensive coordinated system of sewage and drainage facilities to which all new construction will conform. He is continually receiving complaints from property owners and from corporations desiring to start new residential and commercial developments, but the lack of trunk sewers and the poor condition of sewers prevents improvement of the present layout, and until capital funds are provided no relief can be given. The work necessary in bringing the sewer system up to the proper standards is of such magnitude that it is believed that it can best be accomplished by a bond issue.

Expenditure of the funds from the bond issue will be spread over a period of five years. Extension of existing trunk sewers into new industrial and residential areas will cost $1,150,000. A sum of $2,000,000 will be devoted to extensions of sewage treatment plants to prevent raw sewage from emptying into the bay. In addition, $1,850,000 will be spent for the replacement of very old existing sewers.

These last are believed in many cases to be more than 50 years old, although the records of the majority of them were destroyed in the earthquake and fire of 1906. Some of the sewers to be replaced are in the waterfront section of San Francisco, which is subject to ground settlement; this settlement has created sumps, preventing the sewers from functioning properly.

• • •

WPA Cuts Rolls a Million In a Year

More than 1,000,000 persons have been dropped from work relief projects within the 12 month period ending Sept. 28, according to WPA records. The records showed that 1,456,915 were employed on projects during the week ending Sept. 18, compared with 2,481,516 during the week ending Sept. 28, 1936.

The organization intends to employ an average of 1,650,000 persons during the fiscal year ending next June 30. Officials point out that the rolls increase during the winter months.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, White Sulphur Springs, W. Va., Oct. 27-29.

HIGHWAY RESEARCH BOARD, annual meeting, Washington, D. C., Dec. 1-3.

THE ASPHALT INSTITUTE, national asphalt conference, Memphis, Dec. 6-13.

ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, annual meeting, Memphis, Dec. 6-11.

UNIVERSITY OF KENTUCKY, road and street school, Lexington, Ky., Dec. 6-9.

REGIONAL AND LOCAL

SECTION MEETINGS, AMERICAN WATER WORKS ASSOCIATION:
Virginia, Richmond, Nov. 4-6.
Missouri Valley, Omaha, Neb., Nov. 4-6
Wisconsin, Green Bay, Nov. 8-10.

AMERICAN ASSOCIATION OF ENGINEERS, annual meeting of the Illinois Conference of Professional Engineers, Hotel Jefferson, Peoria, Oct. 22-23.

TEXAS PUBLIC HEALTH ASSOCIATION, annual meeting, Dallas, Nov. 1-3.

ELECTIONS AND ACTIVITIES

O. J. RIPPLE was elected president of the Rocky Mountain section of the American Water Works Association at its Santa Fe meeting, and Ben V. Howe was re-elected secretary and treasurer.

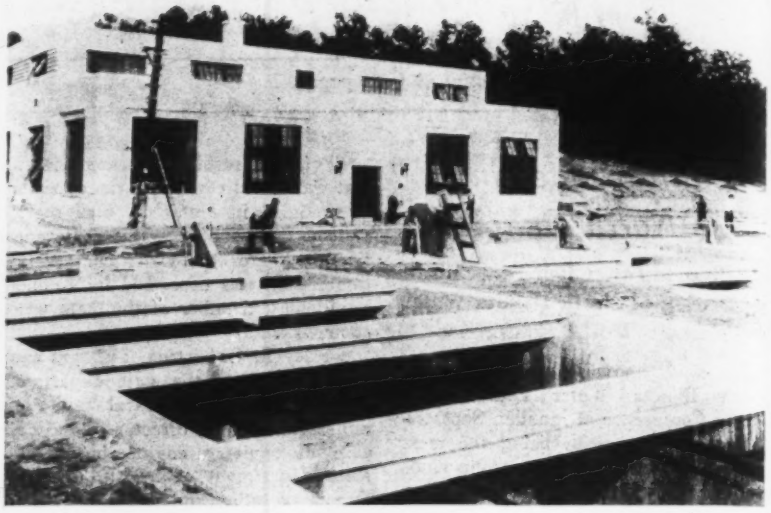
THE OCTAVE CHANUTE MEDAL for the years 1935-1937 has been awarded by the Western Society of Engineers to Prof. Wilbur M. Wilson, professor of structural engineering at the University of Illinois, for his paper on "The Present Status of Structural Welding."

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS has elected the following new officers for 1938: president, H. N. Davis, president of Stevens Institute of Technology; and vice-president, F. O. Hoagland, Pratt & Whitney Division, Niles-Bement-Pond Co.; B. M. Brigman, Dean of Speed Scientific School; Harte Cooke, McIntosh & Seymour Corp.; W. H. McBryde, consulting engineer; and L. W. Wallace, director of the division of engineering research, Association of American Railroads.

• • •

License Examinations

NEW YORK: Examinations for professional engineering Jan. 24-26, and for land surveying Jan. 27, at Albany, Buffalo, New York and Syracuse. Applications must be filed Nov. 1.



MODERNIZING A SEWAGE PLANT

INTRENCHMENT CREEK sewage plant at Atlanta formerly had some of the first Imhoff tanks used in this country. These tanks have now been remodelled to serve as clarifiers. Incorporating novel features also in its rebuilding, the Intrenchment Creek Plant will provide for introduction of carbon dioxide gas into the sewage to control the excessively high alkalinity caused by caustic wastes from textile plants. The carbon dioxide will be introduced into the sewage in the tanks.

The rebuilt plant is scheduled to open in a few weeks. Wiedeman & Singleton, Atlanta, are the consultants.

Adverse Report Presented On Okeechobee Canal

The Board of Engineers for Rivers and Harbors has reported to the House Rivers and Harbors Committee that it would not be advisable at the present time to undertake construction of an improved system of canals between Lake Okeechobee, Fla. and the Atlantic Ocean. "The existing project in the Caloosahatchee and Lake Okeechobee drainage areas," the report said, "will afford an adequate outlet for the commerce of the region, and the costly improvement of the other drainage canals is not warranted by the prospective needs of navigation."

It had been proposed to undertake enlargement of the St. Lucie, West Palm Beach, North New River, Miami, and Hillsboro canals.

• • •

Michigan Ave. Traffic Cut By New Bridge

On Oct. 6, the day after Chicago's new Outer Drive bridge was opened to the public (*ENR*, Oct. 7, 1937, p. 580), surveys showed a reduction of traffic on Michigan Ave. of 44 per cent, which was attributed to the relieving effect of the new route.

During the rush hour from 7:30 a.m. to 8:30 a.m., traffic on Michigan Ave., which would normally be 4,500 vehicles at that hour, amounted to only 2,562. During the same period 3,816 cars passed over the new Outer Drive bridge.

During the day of the dedication 150,000 cars passed over the bridge, traffic continuing dense until midnight.

• • •

Sales Tax Rules Changed In Utah

A change in the regulations on the collection of the Utah state sales tax on building materials will become effective Nov. 1.

Under the new regulations, in the case of a contract for materials and services on a job requiring building materials, the contractor will be considered the consumer and will have to pay the sales tax. On the other hand, if the contractor agrees to furnish materials and supplies at a fixed price or at the regular retail price and to perform construction service for an additional agreed price or on a time basis, it will be considered that he has purchased the materials and supplies for resale, and the tax will be collected from the owner.

The Utah law provides that the tax be levied on the final sale.

OBITUARY

RALPH A. QUIMBY who entered consulting practice about 20 years ago after 40 years service in the engineering department of the city of Boston, died recently at the age of 82.

PAUL GASSER, an architect who had practiced in Cuba and Florida and was for many years building commissioner of Tampa, died recently in Cincinnati at the age of 65.

ANDREW D. STALKER, assistant waterworks engineer of the city of Ottawa in charge of the city filtration plant, died there Sept. 30 at the age of 46. Except for an interval of war service, Mr. Stalker had been with the city since 1911.

ALEXANDER R. LARSON, 56, Buffalo, N.Y., construction engineer, died there Oct. 2. For the past five years Mr. Larson has been connected with the Hydro Construction Co., and for many years before that he was with the Turner Construction Co. in New York City.

CHARLES R. ALLEN, consulting engineer, died recently at the age of 64 at his home in Saratoga Springs, N. Y. Before entering private practice, Mr. Allen was connected for many years with the New York state engineer department and the state highway department.

FRANCIS H. KENDALL, county engineer of Middlesex county, Mass., died Oct. 7 at Montague City, Mass., at the age of 68. Mr. Kendall had been connected with the county engineer's office since his graduation in 1890 from the Massachusetts Institute of Technology and he had been county engineer since 1894.

JOHN GRIFFITHS, founder of the Chicago contracting firm of John Griffiths & Sons Co. and a contractor in Chicago since 1873, died there Oct. 7 at the age of 91. Mr. Griffiths was the builder of many of Chicago's largest Loop structures, including the new post office, the union station, the Civic Opera Building and the Merchandise Mart.

WILLIAM F. LEHR, president-treasurer of the Kellermann Contracting Co., St. Louis, connected with the company for more than 50 years, died there Oct. 5 at the age of 68. The company of which Mr. Lehr was head had constructed many buildings in St. Louis, including the present city hall and morgue and Concordia seminary. The most recent job handled by the company was the interior of the Civil Court building.

CHARLES A. EDABURN, general superintendent and engineer of the Puget Sound Bridge & Dredging Co. of Seattle, died Sept. 29 at Cordova, Alaska, where he was supervising construction of a breakwater, of injuries received when an anchor fell on him. Mr. Edaburn had been connected with the Puget Sound Bridge & Dredging Co. since his graduation from Iowa State College 16 years ago and had supervised river and harbor work along the northwest coast as well as the construction of two bridges in Seattle.

HARRY M. HERBERT, consulting civil engineer who retired from practice some years ago, died in Seaside Heights, N.J., on Oct. 7 at the age of 81. A graduate in 1878 of Rutgers College, Mr. Herbert served for several years as an assistant engineer in the U. S. Engineer Department. He then entered railway work for a number of lines, finally becoming chief engineer of the Delaware, Lackawanna & Western Railroad. Later entering consulting practice, he became chief engineer of Camdem, Trenton and other New Jersey cities.

JOHN H. DWYER, who retired last year from the position of assistant engineer in the way and structures department of the Brooklyn-Manhattan Transit Corp., and who had been connected with rapid transit in Brooklyn since 1884, died Oct. 12 in New York City at the age of 81. Mr. Dwyer was a graduate in 1877 of Goldsmith's Scientific School in New York City and served for several years on the staff of the New Jersey engineering firm of Mallory & Miller. In 1880 he joined the engineering staff of the West Shore Railroad, and four years later became an engineer for the Brooklyn Elevated Railroad Co., holding this position for ten years. After four years supervising construction of waterworks for the city of Brooklyn, he returned to rapid transit work in the engineering department of the Brooklyn Rapid Transit Corp., being appointed to the staff of the chief engineer in 1913.

• • •

Mexico Plans New Port

The Mexican government plans to construct a deep water port at Laguna de la Resaca, situated sixteen miles from the Gulf of Mexico and six miles from Matamoros, which is immediately across the Rio Grande from Brownsville, Texas. A preliminary investigation of the project showed that the creation of the proposed port would cost about $3,500,000, including dredging of the channel and turning basin and construction of docks and loading facilities.

PERSONAL

ARMAND CIRCE, formerly assistant director of L'Ecole Polytechnique, Montreal, has been made director of the Montreal Technical School.

CLARENCE M. ALTHOUSE, formerly junior district engineer for the Socony-Vacuum Oil Co. in the Philadelphia district, has been made district engineer for the company in the Pittsburgh district.

ERIC FLEMING, until recently engineer-chief of the progress and cost section of the branch of planning and state cooperation of the National Park Service at Washington, is now with the design staff of the Ambursen Dam Co. of New York City.

HERBERT C. SADLER, dean of the college of engineering at the University of Michigan since 1928, has resigned that position. His resignation follows a six months leave of absence taken last May because of illness. He will continue his connection with the faculty, of which he has been a member since 1900, as Alexander Ziwet professor of engineering.

MICHAEL L. CONNEEN, formerly district engineer in the Pennsylvania state highway department, has been elected president of J. Jacob Shannon & Co., Philadelphia construction equipment dealers. Mr. Conneen, a graduate of Villanova College in 1902, was head of the Conneen Construction Co. before his connection with the state highway department.

GEORGE R. MACLEOD, assistant chief engineer of the city of Montreal and chief engineer of the technical service department of the city, retired the first of this month at the age of 66 after 25 years in the service of the city. Mr. Macleod graduated from McGill University in 1897. He served on the Imperial Munitions Board in England from 1917 to 1919 on special leave from his duties in Montreal.

REEVES J. NEWSON has resigned his position as president of Community Water Service Co. and its 43 operating companies to enter private practice as a consulting engineer in waterworks and sewerage with offices in New York City. Associated with him will be James T. Harvey, New York City consulting engineer. Prior to his work as operator and engineer for a group of private companies, Mr. Newson was active in water supply work in the municipal field for 12 years, and for eight years he was commissioner and chief engineer of water supply at Lynn, Mass.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

WASTEWAY, ALL-AMERICAN CANAL

OWNER: U. S. Bureau of Reclamation; L. J. Foster, Engineer, Yuma, Ariz.

PROJECT: Construction of Pilot Knob Wasteway and check for All-American Canal, 5 miles west of Yuma, Arizona. The wasteway is 890 ft. long by 81 ft. wide; the check, 308 ft. long by 183 ft. wide.

BIDS: Eleven bids were opened in June, 1937, and contract awarded in August, 1937, ranging from the contract low of $314,519 to a high of $485,169, with completion scheduled for 300 days after award, and minimum hourly wages stipulated of $1.25 for skilled and 45c. for common labor. Government furnishes all materials except rock spalls, riprap, water, insulating tape, solder, flux etc. for electrical work.

LOW BIDDERS:

1. V. R. Dennis Const. Co., San Diego, Calif. (contract) $314,519
2. J. A. Terteling & Sons, Boise, Idaho..... 357,572
3. Gates & Huntley, Los Angeles, Calif..... 361,131

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav., wasteway channel	517,700 c. y.	$0.135	$0.21	$0.22
2. Excav., temporary R.R.	2,500 c. y.	.30	.21	.20
3. Excavation, roads	12,500 c. y.	.35	.21	.20
4. Excav., drainage channels	9,500 c. y.	.17	.21	.15
5. Excav., temporary, canal	45,150 c. y.	.15	.21	.17
6. Structure excav.	10,250 c. y.	.70	.50	.40
7. Compacted fill	500 c. y.	.85	1.00	.50
8. Structure backfill	37,500 c. y.	.25	.15	.30
9. Puddle, tamp backfill	5,000 c. y.	.35	.40	.40
10. Struc. concrete	7,810 c. y.	15.00	16.00	15.00
11. Concrete floor slabs	4,560 c. y.	8.50	10.00	9.00
12. Place reinf. steel	1,830,500 lb.	.012	.0125	.015
13. Install joint filler	5,480 s.f.	.15	.25	.50
14. Install rubber water stops	6,285 l. f.	.40	.25	.50
15. Dry rock paving	1,720 s. y.	1.75	1.00	3.25
16. Riprap	2,100 c. y.	3.50	3.00	2.00
17. Reverse filters	440 c. y.	5.00	4.00	4.00
18. Lay underdrains, 6 in., unem'td. jts	300 l. f.	.40	.50	.30
19. Cast-iron outlet drains, risers, 6 in.	780 l. f.	1.00	.50	.50
20. Erect R.R. bridge struct. steel	86,000 lb.	.02	.03	.02
21. Erect R. R. bridge timber	12 M.b.m.	30.00	40.00	50.00
22. Timber railings	8 M.b.m.	55.00	40.00	70.00
23. Install pipe handrails	7,000 lb.	.07	.10	.10
24. Install radial gates	209,400 lb.	.035	.03	.02
25. Install radial gate mechanisms	49,200 lb.	.07	.03	.04
26. Place bituminous float	100 cwt.	1.50	1.00	4.00
27. Install misc. metal work	22,600 lb.	.08	.03	.10
28. Construct engine house	..... L. S.	250.00	500.00	100.00
29. Install elec. conduit, to 1¼ in.	1,500 l. f.	.23	.10	.15
30. Install elec. conduit, 1¼ in. plus	2,100 l. f.	.30	.20	.25
31. Install electric conductors	500 lb.	.60	.20	.30
32. Install electric apparatus	4,000 lb.	.10	.10	.10

ARIZONA HIGHWAYS

OWNER: State Highway Dept.; T. S. O'Connell, Engineer, Phoenix, Ariz.

PROJECT: Construction of 2.9 miles grading, draining, aggregate base course and asphalt surfacing on Kingman-Boulder Dam Highway; application of asphalt surfacing on 28 miles of Flagstaff-Fredonia highway; furnishing f.o.b. Phoenix, structural steel and steel factory type sash for warehouse.

BIDS: Seven bids were opened for each of the highway projects and four for the building materials in September 1937, with proposals ranging from the contract low of $133,614 to a high of $155,917 for the Kingman-Boulder project, and from $33,084 to a high of $38,716 for the Fredonia project. Warehouse material bids ranged from a contract low of $8,556 to a high of $10,599. Minimum hourly rates are stipulated of $1.00 for skilled and 62½c. for common labor.

LOW BIDDERS:

I—Kingman-Boulder Highway

1. Pearson & Dickerson Contrs. Inc., Prescott, Ariz. (contract) $133,614
2. Lee Moor Contr. Co., El Paso, Texas..... 133,194
3. W. E. Orr, Prescott, Ariz..... 153,678

II—Flagstaff-Fredonia Highway

1. Tiffany Const. Co., Phoenix, Ariz. (contract) 33,084
2. Southern California Roads Co., Los Angeles, Cal. 33,401
3. Skousen Bros., Albuquerque, N. M..... 36,941

III—Warehouse materials, Phoenix

1. Allison Steel Mfg. Co., Phoenix, Ariz. (contract) 8,556
2. Pennsylvania Iron & Steel Co., Los Angeles, Cal. 9,054
3. Baker-Thomas Lime & Cement Co., Phoenix, Ariz. 10,153

I — KINGMAN-BOULDER DAM HIGHWAY

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Roadway excav. unclass.	76,172 c. y.	$0.80	$0.95	$0.80
2. Slides, overbreakage	6,000 c. y.	.60	.7125	.60
3. Drainage excav. unclass.	5,628 c. y.	.80	.70	.80
4. Grader ditches	650 l. f.	.10	.10	.10
5. Structural excav. unclass.	1,026 c. y.	2.50	2.00	2.00
6. Station yard overhaul	83,461 c. y.	.025	.03	.02
7. Cubic yard mile haul	536 c. y.	.30	.40	.20
8. Imported borrow	23,844 c. y.	.16	.16	.18
9. Imported borrow haul	28,121 c. y. m.	.18	.15	.15
10. Agg. base course	7,986 ton	.65	.50	.60
11. Sprinkling	103 m. gal.	2.50	1.00	2.00
12. Rolling	890 hr.	3.00	2.65	2.50
13. Concrete, Cl. A	570 c. y.	21.00	17.00	22.00
14. Reinf. steel, bars	65,565 lb.	.06	.05	.05
15. C. m. p., 18 in.	298 l. f.	2.25	1.75	1.90
16. C. m. p., 24 in.	370 l. f.	3.25	2.70	2.60
17. C. m. p., 30 in.	246 l. f.	3.75	3.35	3.20
18. C. m. p., 36 in.	612 l. f.	5.25	5.00	5.20
19. C. m. p., 42 in.	192 l. f.	6.25	6.00	6.00
20. C. m. p., 48 in.	128 l. f.	7.25	6.90	7.00
21. Riprap	161 c. y.	2.25	2.00	1.50
22. Standard line fence	27,048 l. f.	.09	.09	.10
23. Wire gates, type 2	6 ea.	5.00	5.00	6.00
24. Road guard	9,625 l. f.	1.20	.95	1.25
25. Guide posts	145 ea.	2.00	2.35	3.50
26. R/w markers, type A	64 ea.	2.00	2.50	3.50
27. Road oil	38,672 gal.	.07	.06	.08
28. Blotter material	515 ton	1.50	1.50	2.50
29. Remove conc. bridge	..... L. S.	300.00	350.00	1,500.00
30. Reset water line, ¾-in.	110 l. f.	.50	.10	.20

II — FLAGSTAFF-FREDONIA HIGHWAY

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Sprinkling	737 M. g.	$4.50	$3.50	$5.00
2. Rolling	447 hr.	3.50	3.25	4.00
3. Road oil, SC-2	276,933 gal.	.097	.10	.11
4. Blotter material	670 c. y.	2.00	2.50	1.50

III — WAREHOUSE MATERIALS

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Structural steel, f. o. b.	132,000 lb.	$0.0589	$0.0634	$0.071
2. Pivoted steel windows, no glass, No. 22 mullions, 5 ft. 2 in. x 6 ft. ¾ in.	44 ea.	9.69	8.50	9.69
3. Pivoted stl. windows, no glass, 5 ft. 2 in. x 6 ft. ¾ in.	8 ea.	9.12	8.00	9.12
4. Pivoted steel windows, no glass, No. 14 mullions, 3 ft. 5-¾ in. x 6 ft. ¾ in.	28 ea.	8.41	7.375	8.41
5. Pivoted steel windows, no glass, No. 2 mullions, 6 ft. 10-¼ in. x 6 ft. ¾ in.	4 ea.	11.54	10.125	11.54

(*Additional Contract Unit Prices on second following page*)